Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

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Washington Conservation Reserve Enhancement Program

Agency: U.S. Department of Agriculture, Farm Services Agency, Washington, D.C.

Consultation Conducted By: National Marine Fisheries Service, Northwest Region
U.S. Fish and Wildlife Service, Western Washington Office

Date Issued:

Donna Darm	Gerry A. Jackson
Acting Regional Administrator	Manager
Northwest Region	Western Washington Office
National Marine Fisheries Service	U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

This biological opinion concludes that implementation of the Washington Conservation Reserve Enhancement Program will not jeopardize the continued existence of threatened or endangered species or species which are listed or proposed for listing under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.)(Act). The Opinion was prepared by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (jointly, the Services) in response to the Farm Service Agency's (FSA) written request to the Services for formal consultation dated October 18, 1999, and amended on April 25, 2000.

The Conservation Reserve Enhancement Program (CREP) was established to provide a flexible and cost-effective means to address agriculture-related environmental issues by targeting Federal and state funding for restoration projects in geographic regions of particular environmental sensitivity. In April 1999 the State of Washington submitted a CREP contract proposal to the FSA to enhance riparian habitat conditions on agricultural lands along streams which provide important habitat for listed salmonid species.

The program is cooperatively administered by the Farm Service Agency and the Washington State Conservation Commission and relies on voluntary participation by landowners. The farmers and ranchers who participate in the program sign 10- to 15- year contracts with the Federal Government, agreeing to remove their land from agricultural production and planting it to woody or shrub vegetation. The landowners will be eligible to receive rental payments and other financial incentives in return for the loss of production from their lands.

The Washington CREP proposal is designed to address water quality degradation that is a direct or indirect result of agricultural activities on private lands along freshwater streams. On a statewide basis, approximately 37 percent of the freshwater salmon streams on private lands in Washington pass through agricultural land use areas. Farming and ranching activities on these lands have led to removal or elimination of native riparian vegetation with resultant increases in water temperature, rates of sedimentation, and changes in channel morphology.

The project area includes private agricultural lands along streams identified in the 1993 Salmon and Steelhead Status Inventory (SASSI) that provide habitat for salmonid stocks in depressed or critical condition and that are listed under the Federal Endangered Species Act. Up to 100,000 acres of private cropland and grazing land, including 3-4,000 miles of riparian area, will be eligible for inclusion in this program. The riparian forest buffer is the primary conservation practice authorized in the Washington CREP. It is anticipated that restoring forested riparian buffers will have a significant positive impact on the targeted freshwater streams.

The six objectives of the Washington CREP are directly related to improvement of riparian and aquatic ecosystems that provide key habitats for salmonids. These six objectives are:

- Restore 100 percent of the area enrolled for the riparian forest practice to a properly functioning condition for distribution and growth of woody plant species.

- Reduce sediment and nutrient pollution from agricultural lands next to the riparian buffers by more than 50 percent.

- Establish adequate vegetation on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.

- Reduce the rate of stream water heating to ambient levels by planting adequate vegetation on all riparian buffer lands.

- Help farmers and ranchers to meet the water quality requirements established under Federal law and Washington's agricultural water quality laws.

- Provide adequate riparian buffers on 2,700 stream miles to permit natural restoration of stream hydraulic and geomorphic characteristics that meet the habitat requirements of salmon and trout.

Washington CREP includes a set of best management practices (BMPs) designed to reduce adverse environmental impacts. These BMPs will be followed on all CREP activities and will be provided to all farmers and ranchers who enroll in the program. The Services regard these BMPs as integral components of the Washington CREP and consider them to be part of the action.

The Services believe that this programmatic consultation on the Washington CREP removes the requirement for most project level consultation. Consequently, unless otherwise identified within the biological opinion (BO), activities performed within the Washington CREP that are consistent with the BMPs described in the biological assessment (BA) and Reasonable and Prudent Measures (RPMs) and Terms and Conditions described in the BO will not require further consultation. However, the Services have identified certain activities which have a greater likelihood of adverse impacts to salmonids and their habitat which will require site-specific consultation. These activities are identified within the BO and include, but are not limited to, actions such as, bankshaping that exceeds 30 linear feet and any activities that are not consistent with the CREP BA (BMPs inclusive) and this BO (Reasonable and Prudent Measures and Terms and Conditions inclusive).

The biological opinion is rendered on the effects of the proposed activities within the riparian zone and is not, per se, an opinion on the adequacy of the buffer to meet all of the requirements for listed species. Both Services have determined that the riparian restoration activities, if installed in accordance with the criteria outlined in the Washington CREP, work towards recovering listed and proposed salmonids and are designed to provide the majority of riparian functions, particularly if maintained beyond the length of the contract (15 years). If the FSA should seek a concurrence on the adequacy of the width of the riparian forest buffer, an analysis on how various forest buffer widths provide different levels of riparian and aquatic ecological functions would be needed. The analysis should also address what functions can be achieved in the relatively short time period of the program (15 years) and how the CREP program might be enhanced to ensure that the buffers are maintained to meet the long term recovery goals outlined in the program objectives.

The Services believe that full achievement of the Washington CREP is likely to make a very substantial contribution to the survival and recovery of those aquatic species covered by this opinion. Nonetheless, the Services also believe that some of the site-specific actions associated with CREP may result in short term adverse effects to listed fish and associated incidental take. Accordingly, the Services provided a set of nondiscretionary “reasonable and prudent measures” in the accompanying incidental take statement which they believe are necessary to minimize the take of listed species associated with the Washington CREP. The opinion also provides a set of “conservation recommendations” based on discretionary actions the Services believe the FSA and U.S. Department of Agriculture can carry out for the conservation of threatened and endangered species.

Species addressed by this opinion include Snake River sockeye salmon (*Oncorhynchus nerka*), Ozette Lake sockeye (*Oncorhynchus nerka*), Snake River fall chinook salmon (*Oncorhynchus tshawytscha*), Snake River spring/summer chinook (*Oncorhynchus tshawytscha*), Upper Columbia River spring-run chinook (*Oncorhynchus tshawytscha*), Upper Willamette spring chinook(*Oncorhynchus tshawytscha*), Puget Sound chinook (*Oncorhynchus tshawytscha*), Lower Columbia River chinook, all runs (*Oncorhynchus tshawytscha*), Hood Canal early run chum salmon (*Oncorhynchus keta*), Columbia River Chum (*Oncorhynchus keta*), Snake River Basin steelhead trout (*Oncorhynchus mykiss*), Upper Columbia River Basin steelhead (*Oncorhynchus mykiss*), Middle Columbia Basin steelhead (*Oncorhynchus mykiss*), Lower Columbia Basin steelhead (*Oncorhynchus mykiss*), Upper Willamette River steelhead (*Oncorhynchus mykiss*), Southwestern Washington / Columbia River cutthroat trout (*Oncorhynchus clarki clarki*), Bull trout (*Salvelinus confluentus*), Bald eagle (*Haliaeetus leucocephalus*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Nelson’s checkermallow (*Sidalcea nelsoniana*), Bradshaw’s lomatium (*Lomatium bradshawi*), and Ute’s ladie’s-tresses (*Spiranthes diluvialis*).

BIOLOGICAL OPINION

This document transmits the U.S. Fish and Wildlife Service and National Marine Fisheries Service's (collectively the Services) biological opinion based on our review of the proposed Washington State Conservation Reserve Enhancement Program (CREP), and its effects on listed and proposed species in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Formal consultation was initiated on April 3, 2000 upon receipt of the Farm Service Agency's (FSA) amendment to the biological assessment.

This Biological Opinion (BO) is based on information provided in the FSA's Biological Assessment (BA), dated October 18, 1999 and amended on April 3,2000, the opinion prepared by the Oregon State Office for the Oregon CREP program, dated June 2, 1999, telephone conversations and correspondence with the FSA, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the Western Washington Office in Lacey, Washington.

Consultation History

On June 1, 1999, the FSA submitted a request for informal consultation to the National Marine Fisheries Service (NMFS) for installation of the riparian buffers (planting) and consultation for this action was completed on June 22, 1999 (Appendix A). A draft copy of the biological assessment covering all other CREP activities (use of herbicides, installation of livestock crossings, bank stabilization etc) was prepared in August, 1998 and sent to the Upper Columbia Basin Field Office in Spokane. The Farm Service Agency requested comments to the draft in an e-mail message, dated August 17, 1999. The Spokane office of the U.S. Fish and Wildlife Service provided input in their September 2, 1999 letter, including the need to change the effects determination for instream work, re-evaluate impacts to eagles from non-noise generating activities, and clarifying the benefits of the program to bull trout. In a subsequent letter, dated December 1, 1999, the Spokane Office indicated that they were unable to process the request for formal consultation due to staffing shortages and that the lead for the CREP program would be transferred to the Western Washington Office (WWO). The WWO reviewed the biological assessment and noted some discrepancies between the Oregon and Washington CREP assessments, including effects determinations and the omission of several species, such as the Columbia white-tail deer, coastal cutthroat trout, Nelson's checkermallow and Bradshaw's lomatium, as well as three of the salmon species, which were listed on the species list for Washington. The WWO addressed the need to incorporate these revisions in a letter dated January 20, 2000 (Appendix B). Due to staffing changes in the Washington DC Office of the FSA, including the transfer of the biologist who prepared the biological assessment, the responsibility of making revisions to the assessment was directed to the Washington State FSA office in Spokane. The amendment containing the additional information and requesting initiation of formal consultation was received in the Western Washington Office on April 3, 2000

(Appendix C). A letter from FSA (Spokane) was sent to NMFS requesting inclusion of 3 additional species in the BA on July 18, 2000 (Appendix D).

In May, 2000, a multi-agency committee (USFWS, NMFS, Washington State Department of Agriculture, Environmental Protection Agency and others) was established to evaluate the effects of the most commonly used agricultural chemicals, including those proposed for the CREP program, on listed salmonids. This information was used in the development of the Best Management Practices and Terms and Conditions of this Biological Opinion.

Other sources of information used in this opinion include the *Washington State's Proposal to Participate in the Conservation Reserve Enhancement Program*, dated April 19, 1999, *Agreement between the U.S. Department of Agriculture Commodity Credit Union and the State of Washington Concerning the Implementation of a Conservation Reserve Enhancement Program* (CREP Co-op Agreement, Appendix E), dated October 19, 1998, the FSA's CREP Manual, file materials, the Services' Biological Opinions on the USFWS Partners for Fish and Wildlife program, all relevant approved recovery plans, and the Federal Register notices of proposed and final listing rules for species covered in this opinion (Table 1). This programmatic consultation covers the Washington CREP through the year 2015.

Description of the Proposed Action

<u>Overview</u>

The following description of the CREP program is taken largely from the CREP BA and from correspondence among the Services and FSA. The CREP BA was modified by the January 20, 2000 letter to incorporate a number of recommendations made by the USFWS regarding the proposed action and to clarify questions raised in the USFWS' letter to FSA. The CREP program is based on the CRP authorized under the provisions of the Food Security Act of 1985, as amended (16 U.S.C. 3830 *et seq*.) and the regulations at 7 C.F.R. Part 1410. As a result, conservation practices referred to in the CREP BA and other supporting documents are defined according to Conservation Reserve Program (CRP) rules and regulations (Appendix F). The proposed action is limited to the installation and maintenance of those conservation practices referred to in the CREP BA. Activities that differ from those described in the BA will require additional site-specific consultation with the Services.

The CREP project area includes private agricultural lands along all streams in Washington which currently or potentially provides habitat for 17 species or Evolutionarily Significant Units (ESU) of salmon and trout which are listed under the Act. Up to 100,000 acres of private cropland and grazing land will be eligible for inclusion in this program. Under the program, riparian buffers averaging 100 feet in width would be installed along approximately 3,000-4,000 miles of streams. It is estimated that there are approximately 50,000 miles of anadromous fish-bearing streams in the state. About 15-20,000 miles pass through privately owned agricultural lands. The scope of the Washington CREP program is adequate to address about 20 percent of the highest priority salmon streams on agricultural lands. The stream segments eligible under the program are those identified in the 1993 Salmon and Steelhead Status Inventory and are highlighted in Figure 1.

In June 1999, the CREP agreement between the USDA and the state of Washington incorporated new requirements for the Natural Resources Conservation Service (NRCS) riparian buffer standard (Appendix G) which increased the buffer to 75 percent of a site-potential tree height or 50 feet in areas where trees were not historically present or cannot be re-established (see Appendix H). A new conservation practice, the Herbaceous Riparian Cover practice, has also been approved by the NRCS and is awaiting USDA clearance before it may be used in the Washington CREP program. If approved as proposed, it will be eligible for inclusion in the program.

This CREP proposal is designed to address water quality degradation which is a direct or indirect result of agricultural activities on private lands along freshwater streams. Farming and ranching activities on these lands have led to removal or elimination of native riparian vegetation with resultant increases in water temperature, rates of sedimentation, and changes in channel morphology.

Under this program, farmers and ranchers who voluntarily participate will enter into a contract with the Federal government for 10 to 15 years, agreeing to remove portions of their land from agricultural production and plant grass, shrubs and trees in place of agricultural commodities. These producers will be eligible to receive rental payments and other financial assistance in return for removal of their lands from agricultural production. For non-irrigated land, farmers and ranchers will be paid the federally-established dry land soil rental rates. Where land is irrigated, an irrigated soil rental rate will be paid when farmers and ranchers agree to lease the appurtenant water right to the State for instream use.

Farmers and ranchers will receive incentive payments for participation in this program which will be 35 percent above the normal annual rental rate for installation of riparian buffers. Where at least 50 percent of the land along a five mile stretch of stream is enrolled under the program prior to January 1, 2002, producers will receive an additional incentive equal to four times the base annual rental rate. A total of 75 percent of the installation cost of conservation practices will be paid through a combination of State and Federal funds. The total cost of the CREP project is estimated to be $251,000,000 over 15 years.

Table 1. Species covered in the Biological Opinion for the Washington Conservation Reserve Enhancement Program.

GROUP	SPECIES	STATUS	LEAD AGENCY
Fishes	Snake River sockeye salmon (*Oncorhynchus nerka*)	E, CH	NMFS
	Ozette Lake sockeye salmon (*Oncorhynchus nerka*)	T, CH	NMFS
	Snake River fall chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha*)	E, CH	NMFS
	Lower Columbia River chinook salmon, all runs (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Puget Sound chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Upper Willamette River spring chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Hood Canal early-run Chum salmon (*Oncorhynchus keta*)	T, CH	NMFS
	Columbia River Chum salmon (*Oncorhynchus keta*)	T, CH	NMFS
	Snake River steelhead (*Oncorhynchus mykiss*)	T, CH	NMFS
	Upper Columbia River steelhead (*Oncorhynchus mykiss*)	E, CH	NMFS
	Middle Columbia River steelhead (*Oncorhynchus mykiss*)	T, CH	NMFS
	Lower Columbia River steelhead (*Oncorhynchus mykiss*)	T, CH	NMFS
	Upper Willamette River steelhead (*Oncorhynchus mykiss*)	T, CH	NMFS

GROUP	SPECIES	STATUS	LEAD AGENCY
	Southwestern Washington / Columbia River cutthroat trout (*Oncorhynchus clarki clarki*)	PT	USFWS
Fish Continued	Bull trout (*Salvelinus confluentus*)	T	USFWS
Birds	Bald eagle (*Haliaeetus leucocephalus*)	T	USFWS
Mammals	Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	E	USFWS
Plants	Nelson's checkermallow (*Sidalcea nelsoniana*)	T	USFWS
	Bradshaw's lomatium (*Lomatium bradshawi*)	E	USFWS
	Ute's Ladie's tresses (*Spiranthes diluvialis*)	T	USFWS

E = Endangered, T = Threatened, PE = Proposed Endangered, PT = Proposed Threatened, CH = Critical Habitat, PCH = Proposed Critical Habitat

<u>Objectives of the Washington CREP</u>

The six objectives of the Washington CREP are directly related to improvement of freshwater stream systems which provide key habitat for salmonids. These objectives are:

1. Restore 100 percent of the area enrolled for the riparian forest practice to a properly functioning condition in terms of distribution and growth of woody plant species.

2. Reduce sediment and nutrient pollution from agricultural lands adjacent to the riparian buffers by more than 50 percent.

3. Establish adequate vegetation on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.

4. Reduce the rate of stream water heating to ambient levels by planting adequate vegetation on all riparian buffer lands.

5. Provide a contributing mechanism for farmers and ranchers to meet the water quality requirements established under Federal law and Washington's agricultural water quality laws.

6. Provide adequate riparian buffers on 2,700 stream miles to permit natural restoration of stream hydraulic and geomorphic characteristics which meet the habitat requirements of salmon and trout.

Description of the Washington CREP

The Washington CREP is a comprehensive, state-wide program designed to reduce and mitigate agriculture-related impacts on streams that provide current or historical habitat for salmon and trout listed pursuant to the Act. In addition to the CREP BA, details of the Washington CREP program are set forth in the CREP Co-op Agreement and in FSA's CREP Manual.

The primary mechanism to accomplish this program will be through the establishment of forested riparian buffers. Farmers and ranchers will be afforded the opportunity to voluntarily enter into 10 to 15 year contracts with USDA to plant grasses, shrubs and/or trees on riparian lands they own or manage along salmon and trout streams. Applications from all eligible producers will be accepted into the program on a first-come, first-served basis up to a maximum enrollment of 100,000 acres. Figure 1 of the BA depicts the areas eligible for enrollment under this program, and is herein incorporated by reference.

Forest riparian buffers (practice code CP 22) will be the primary conservation practice used for this program. Grass filter strips (practice code CP 21) and herbaceous riparian cover (if approved as proposed) will be used on cropland only where analysis of available records (historical accounts and photographs) indicates that no trees or shrubs, including willow (*Salix* spp.) or cottonwoods, existed on the site within historic times. Additionally, if the herbaceous riparian cover practice is approved as proposed, the grass filter strip practice will only be used upslope of the herbaceous riparian cover practice.

These conservation practices shall be installed in accord with all applicable CRP statutes (16 U.S.C. 3831 *et seq.*), regulations and the CREP Manual. In addition, the practices shall be consistent with the specifications outlined in the applicable NRCS Field Office Technical Guides. Appendices E and F of the BA consist of a current copy of the CRP practices from the FSA national policy handbook (2-CRP) and copies of the current NRCS Washington Practice Standards and Specifications (incorporated herein by reference).

The State of Washington, NRCS, USFWS, NMFS, and the Environmental Protection Agency (EPA) have signed an October 19, 1998 Memorandum of Understanding (NRCS MOU) which provides for the enhancement of the NRCS Field Office Technical Guides (FOTG) as appropriate to better meet endangered species and water quality issues. The CREP Co-op Agreement between the State of Washington, the Commodity Credit Corporation and FSA, signed April 19, 1999 recognizes that future modifications to the current FOTGs may be implemented, and it provides for the modified practice standards to be implemented within the context of the CREP. The state-wide Agriculture, Fish and Water (AFW) forum, a working group representing agriculture, federal and state agencies, tribes, and the environmental community, is chartered with updating the FOTGs and ensuring adequate instream flows by updating agricultural practices to meet requirements under the Endangered Species and Clean Water Acts. The Services fully expect these ongoing modifications will provide greater protection to the listed species targeted under this program. A virtually identical group under the auspices of the AFW process is reviewing the practices of the irrigation districts to ensure that adequate stream flows and fish passage, among other requirements, are provided for salmon, steelhead, coastal cutthroat, and bull trout.

According to the BA, riparian buffers will be installed on 90 percent of the lands enrolled under the CREP. During negotiations in 1999, the National Marine Fisheries Service (NMFS), Natural Resources Conservation Service (NRCS), Washington State Department of Agriculture, and the FSA agreed to seventy-five percent of a site potential tree height as the minimum buffer width for the Washington State CREP program. For most sites, the site potential tree height shall be defined as the average height at 100 years of the tallest conifer species native to the site. For sites that historically supported cottonwoods as the largest tree, the site potential tree height is defined as the height of a 50-year old black cottonwood. In areas where trees did not historically occur or where they cannot be established, the minimum width of the buffer was set at 50 feet and will be planted to woody shrubs, forbs or other vegetation native to the site. The program will fund activities up to a maximum width of 150 feet. However, this width can be exceeded to accommodate particular resource objectives on a site-specific basis.

It is important to note that CREP is a national habitat restoration program that allows practices to be customized to meet local, state, and regional needs. This is particularly true as applied to the width and composition of the riparian buffers. This biological opinion is rendered on the effects of the activities proposed within the riparian buffer zone and is not, per se, an opinion on the adequacy of buffer widths to meet all of the functional needs of listed salmonids and, therefore, all of the requirements under the Endangered Species or Clean Water Acts. These determinations must be made on a site by site basis and reflect topography, land use practices, fish needs within particular stretches of rivers, etc. These issues are currently being negotiated within the context of the AFW process with the expectation that “Best Management Practices” will be adopted into the NRCS farm practices that will, if implemented, meet all of the requirements under both the Endangered Species Act and the Clean Water Act.

Under this program, funds can only be used to install and maintain conservation practices on eligible cropland and marginal pastureland. No instream work (i.e., work within the "streambank width") will be undertaken except for the installation of offstream livestock watering facilities and livestock crossings across small streams. The definition of the term "streambank width" as used in the BA, CREP Co-op Agreement, and CREP Manual is the width of the stream at "bankfull discharge":

> *Bankfull discharge:* The discharge that controls the shape of the stream channel; the discharge which is most efficient, transporting the most sediment and water with the least amount of energy. The level of the active floodplain (Leopold 1994).

According to the BA, nearly 60 percent of the land which will be enrolled under this program is pasture or range land. Pursuant to existing law (16 U.S.C. 3831(b)(3)), marginal pastureland can only be enrolled in the Conservation Reserve Program, and thus in CREP, if planted with trees in or near riparian areas. Therefore, all marginal pastureland will be planted with trees.

In any case where USDA pays the irrigated cropland rental rates to a participating farmer, that portion of the existing water right appurtenant to the enrolled acreage shall be dedicated for instream flow pursuant to the laws of the State of Washington for the duration of the CREP contract. At the end of the CREP contract, water right holders will have several options: resume the right for the authorized purpose on all lands to which it is appurtenant, continue leasing the water for instream use, transfer the instream right to the State, transfer the right to other lands, or abandon the water right. Based on the average statewide agricultural irrigation water usage of three acre feet for each acre of agricultural land, as cited in the BA, CREP is projected to restore up to 60,000 acre feet of water per year to salmon and trout streams.

The Washington CREP proposes a cumulative impact incentive designed to encourage adjacent farmers and ranchers to enter the program to concentrate the use of restoration practices, thereby increasing the effectiveness of those practices. Under this incentive system, USDA will make a one-time payment to all enrollees when a sufficient number of landowners agree to participate along a particular stream. This incentive payment would be made in any case where a total of at least 50 percent of the streambank within a five-mile stream segment is enrolled under the program. The incentive will be four times the base annual rental rate (without inclusion of any other incentives) for each acre enrolled. Enrollees would be eligible for this incentive only through the end of calendar year 2002, which will encourage producers to enroll soon after the program is established. Under this CREP agreement, farmers and ranchers will be eligible to enroll in contracts of 10 to 15 years duration, but administering agencies intend to encourage enrollment in longer contracts.

The State and USDA will jointly administer this CREP. The primary responsibilities of the various Federal and State agencies involved in the implementation of this CREP are as follows:

The FSA will:

- develop recommendations for soil rental rates;
- work with Washington Department of Fish and Wildlife (WDFW), NMFS and USFWS to determine streams eligible for inclusion in the program;
- determine eligibility for the cumulative impact payments;
- approve CREP contracts; and
- prepare monitoring reports for anticipated incidental take and insure program compliance with the Endangered Species and Clean Water Acts

The NRCS will:

- determine acreage eligible and suitable for enrollment;
- participate in development and approval of all conservation plans;
- develop specifications, provide oversight during installation, certify completion of filter strips and wetland restoration practices;
- complete required status reviews; and
- develop tree planting specifications, provide oversight during installation and certify the completion of all installations of forested riparian buffers.

The Conservation District, funded by the State of Washington, will:

- provide outreach on the program and assist landowners in the development of conservation plans;
- provide technical assistance in the development of conservation plans; and
- coordinate and fund the overall the annual monitoring effort by the various State agencies.

<u>Monitoring</u>

The Washington CREP monitoring program will build on existing monitoring programs of the Department of Ecology, Washington State Conservation Commission, and the Natural Resources Conservation Service. Where available, this program will utilize existing data from other Federal and citizen monitoring programs.

As a condition for funding, participant landowners must agree to allow access to sites for monitoring purposes including pre-treatment baseline data collection. Participants will be informed that effectiveness monitoring sites will be selected randomly. Participants will be informed that data will be collected to assess the effectiveness of the program in reaching water quality and aquatic habitat goals and not for enforcement purposes. If potential violations are discovered, the appropriate agency will work cooperatively with the landowner to achieve compliance.

The near-term focus of the CREP monitoring program will be on project documentation, plant growth and survival, and the effects of riparian treatments on instream water quality conditions. The extended response time associated with riparian forest growth and recovery necessitates a commitment to long-term monitoring. Mid-term monitoring will incorporate stream shading, temperature monitoring and channel morphology. Large woody debris recruitment is a long-term component of the CREP.

The Washington Conservation District currently collects data on riparian enhancement activities throughout the state using a written survey method. This inventory should be expanded to address specific monitoring questions for the CREP.

Effectiveness monitoring will focus on the specific project objectives and will be addressed in the field. Data collection will follow existing protocols. Primary focus of the monitoring plan will be to insure that the practices are accomplished and meet the objectives outlined in the CREP contract. The NRCS and/or FSA will evaluate planting success and effectiveness of fencing, bank stabilization and livestock crossings for all enrolled properties. A subset of completed CREP projects will be randomly selected to evaluate the long-term success of the CREP program. Where feasible, monitoring will include both treated and reference sites.

Water quality parameters are monitored at selected sites throughout the state by the Department of Ecology. These include stream temperature, sediment deposition, and agriculture chemical concentrations. Additional water quality monitoring sites may be established at upstream and downstream locations from a subset of the areas treated in the CREP program if not already included in the existing sites. Since the long-term benefits of restoration activities such as planting for shade and future recruitment of large woody material may not be measurable for many years, effectiveness monitoring should occur throughout the life of the program.

Bank stability and stream channel morphology should also be evaluated. Riparian tree growth and survival will be assessed by NRCS and will include assessment of woody and herbaceous browsing. Fish populations will be sampled as part of WDFWs regular stream surveys to determine if treated reaches provide favorable habitat for salmonids.

Outreach

The overall success of this voluntary program will be directly correlated to the level of enrollment by farmers and ranchers. A critical aspect of securing enrollment is distribution of program information and education of producers. Research has shown that one-on-one discussions of agricultural programs between producers and key individuals (USDA representatives, Extension agents, and other producers) is the most effective way to secure producer participation. Therefore, broad public outreach by Federal and State employees is proposed as a major component of this program.

In addition, the State will develop public outreach material in cooperation with the USDA agencies (FSA, NRCS) and WDFW. Information will address native fish and water quality issues. Local community groups (watershed councils, local FSA committees, and Soil and Water

Conservation Districts) will identify interested landowners and develop cooperative landowner outreach efforts. Several interagency efforts are currently underway to develop criteria for water withdrawals and to review the NRCS standards and guidelines as they relate to agricultural practices. The Agriculture, Fish and Water process (AFW) consists of the Irrigation District (ID) and Field Office Techical Guide (FOTG) Committees. These efforts are being conducted in conjunction with the major agricultural representatives, state legislature, tribes and environmental groups. Some of the outcomes of these negotiations may be incorporated into the CREP program practices in the future.

Best Management Practices

Best management practices (BMPs) are designed to reduce adverse environmental impacts resulting from the installation of CREP practices. The Services consider these BMPs to be part of the CREP action. For the analysis presented in this BO, the Services assume that these BMPs will be binding requirements within each contract. Consequently, the following BMPs will be required of all farmers and ranchers who enroll in the program.

1. All terms and conditions in regulatory permits and other official project authorizations to eliminate or reduce adverse impacts to any endangered or threatened species or their critical habitats will be followed.

2. Restoration activities at individual project sites will be completed in an expeditious manner. In addition, appropriate work timing windows will be used to reduce disturbance and/or displacement of fish and wildlife species in the immediate project area.

3. Vehicular access ways to project sites must minimize mpacts on riparian corridors.

4. Use of heavy equipment and techniques that will result in soil disturbance or compaction of soils, especially on steep or unstable slopes, will be minimized.

5. Vehicles will not enter or cross streams except in cases where no alternative exists. Where stream crossings are required, the number of crossings will be minimized. Vehicles and machinery will cross streams at right angles to the main channel whenever possible. Any stream crossings will be consistent with WDFW hydraulic code instream operating restrictions.

6. Staging and refueling areas will be located outside of the riparian area and away from water sources/drainages to prevent potential contamination of any waterbody.

7. There will be no instream work except for installation of livestock crossings and installation of offstream livestock watering facilities. Bank shaping will be done from the top of the bank.

8. Vegetative planting techniques must not cause major disturbances to soils and slopes. Hand planting is the preferred technique for all planting. Plantings will occur during the appropriate seasonal period for the respective plant species involved.

9. The evaluation of herbicide use will include the accuracy of applications, effects on target and non-target species, and the potential impacts to aquatic and terrestrial ecosystems. All chemical applications will follow label instructions as well as adhere to the guidance in 10 and 11 below. Projects specifications, to be developed by qualified agency personnel, will fully address timing, rate of application and application methodology.

10. Since the use of herbicides to establish riparian vegetation may require application distances closer to the streams than is recommended by the manufacturer on the product labels, the following prioritization shall be given for the 7 chemicals requested for use under the CREP program in order to minimize impacts to both aquatic and terrestrial organisms:

    1. Glyphosate - formulation in Rodeo, rather than Roundup
       Triclopyr - using formulations in Crossbow or Garlon 3A, rather than Garlon 4

    2. Sulfometuron-methyl (trade name Oust)
       Oxyflourfen (trade name Goal)
       2,4-D (amine, or salt formulation)

    The following chemicals are known to be toxic to fish, amphibians, and/or migratory birds or are currently under investigation. These chemicals should only be used if *no other* control mechanisms exist:

    Atrazine and Hexazinone, both triazine derivatives

11. Chemicals shall be applied by hand, using backpack or small vehicle-mounted sprayers (ATV or pickup). There shall be no aerial application of chemicals.

12. Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jutte mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

13. Streambank shaping will only be implemented where streambank stability is extremely poor or where necessary to restore riparian functions. Streambank modification for planting purposes will be thoroughly documented, and on each CREP contract where more than 30 linear feet of streambank is shaped by mechanical equipment, USDA will consult

with the Services. Design of all streambank modification projects will recognize the important wildlife values provided along naturally eroding outside meander curves. Any soil control structures will be bio-engineered to the extent possible. No rip rap will be used under this program for streambank stabilization. No streambank stabilization activity will reduce natural stream functions or floodplain connection.

14. Qualified agency personnel will develop plant specifications detailing seedlings, sources for seed, handling of plant material, and planting techniques. Seedling competition will be reduced by controlling grasses, forbs, and undesirable woody shrubs (non-native) from around each seedling for an appropriate distance. Proper methods to protect seedlings from animal, insect, and environmental damage will be employed.

15. Fence designs (e.g., wire type and wire spacing) will be in accord with NRCS standards. Fencing projects on Puget Island, the Hunting Islands, Price Island, and 2 miles inland from the Columbia River between 2 miles east of Cathlament and 2 miles west of Skamokawa Creek in Wahkiakum County will use only 3-strand barbed wire to minimize impacts to Columbian white-tailed deer and their movements.

16. Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock. Livestock stream crossings will only be constructed on small streams. Crossings will not be placed on the mid- to downstream end of gravel point bars. Crossings will generally be 30 feet or less in width. Any culverts constructed for livestock crossing purposes will meet NMFS guidelines. Livestock fords across streams will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.

17. Native vegetation will be used. Where use of native vegetation is not feasible, similar species which are functional equivalents and known not to be aggressive colonizers may be substituted. Hybrid cottonwoods are not approved for use in this program.

18. For any project within ¼ mile non-line-of-sight or ½ mile line-of-sight of an eagle nest identified by WDFW, no activities producing noise above ambient levels will occur at the site from January 1 to August 31. If a proposed activity is near a bald eagle nest and must occur during this restricted period, site-specific consultation with USFWS will be initiated to evaluate the potential for adverse effects.

19. Survey data from USFWS and Washington Natural Heritage Inventory will be used to identify potential locations where listed and proposed plant species (see Table 2) may be located along stream corridors within the project area. Where required, surveys by trained personnel will be conducted for the presence of these species. Any locations of these plants identified in a survey will be avoided through redesign of the project as necessary.

20. Restoration activities on Puget Island, the Hunting Islands, Price Island, and 2 miles inland from the Columbia River between 2 miles east of Cathlament and 2 miles west of Skamokawa Creek in Wahkiakum County will not occur from June 1 to June 30, to avoid and minimize impacts to Columbian white-tailed deer during the fawning season.

Table 2. Soil type associations of listed and proposed plants that may be affected by the Washington Conservation Reserve Enhancement Program.

Species	Location	Habitat	NRCS Mapped Soil Unit	Soil Series
Nelson's Checkermallow (*Sidalcea nelsoniana*)	Willapa Hills/Coast Range extension Cowlitz County	Wetlands and riparian areas	STATSGO 81 and STATSGO 91	Wapto, Bashaw, Mcalpin; and, Malabon, Coburg, Salem
Ute Ladies'tresses (*Spiranthes diluvialis*)	Okanogan County	Floodplain and wet meadows	STATSGO 81 and STATSGO 91	Wapto, Bashaw, Mcalpin; and, Malabon, Coburg, Salem
Bradshaw's Lomatium (*Lomatium bradshawii*)	Willamette Valley and Clark County in Washington	Wet prairies	STATSGO 81	Wapto, Bashaw, Mcalpin

Note: The USFWS has been able to further refine the soils data provided during informal consultation and development of the FSA's biological assessment. However, additional refinement of the soil types or series on which all CREP projects will require botanical surveys cannot be completed until additional data are made available on the NRCS SSURGO database. Once the relevant data are made available, the USFWS will work with FSA and NRCS to further reduce the required level of survey effort by developing more refined plant/soil associations.

Environmental Baseline

Regulations implementing section 7 of the Act (51 Fed. Reg. 19957; 1986) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress.

The action area is defined to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the action area includes all lands where CREP projects may be implemented within the State of Washington, and all areas downstream from these sites.

The following Environmental Baseline discussion focuses primarily on the baseline conditions of streams inhabited by the 13 listed salmonid fishes that are the target species for the Washington CREP program, and two non-target listed or proposed fish species: the bull trout and coastal cutthroat trout. All of these aquatic species, though variable in their biological and life history traits, would experience the impacts of agricultural practices in similar ways, though to varying degrees. The environmental baseline for non-target terrestrial species is addressed near the end of this section of the Biological Opinion.

The current population status of the proposed, listed and candidate species addressed in this Biological Opinion is described below. For some species, adequate population data are lacking, and habitat conditions provide a means of evaluating the status of the species.

Status of Aquatic Species within the Action Area

Snake River Sockeye Salmon

Snake River sockeye salmon are listed as endangered in the Federal Register (56 Fed. Reg. 58519; 1991). The following summary information is taken from that Federal Register.

Snake River sockeye salmon enter the Columbia River primarily during June and July. Arrival at Redfish Lake, Idaho, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs primarily in October. Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge in April through May, and move immediately into the lake where juveniles feed on plankton for one to three years before migrating to the ocean. Migrants leave Redfish Lake from late April through May, and smolts migrate almost 900 miles to the Pacific Ocean.

The critical habitat for the Snake River sockeye salmon was designated in December 1993 (58 Fed. Reg. 68543; 1993). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks).

Passage at Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) ranges from late April to July, with peak passage from May to late June. Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean. Snake River sockeye salmon usually spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life. Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum. During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish.

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (one to 29 adults counted per year). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and is designated as critical habitat for the species.

Ozette Lake Sockeye Salmon

Ozette Lake sockeye salmon were listed as threatened in March 1999 (64 Fed. Reg.14528; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11750; 1998).

This ESU consists of sockeye salmon that return to Ozette Lake through the Ozette River and currently spawn primarily in lakeshore upwelling areas in Ozette Lake (particularly at Allen's Bay and Olsen's Beach). Minor spawning may occur below Ozette Lake in the Ozette River or in Coal Creek, a tributary of the Ozette River.

Critical Habitat includes all lake areas and river reaches accessible to listed sockeye salmon in Ozette Lake, located in Clallam County, Washington. Accessible areas are those within the historical range of the ESU that can still be occupied by any life stage of sockeye salmon. Inaccessible areas are those above longstanding, naturally impassible barriers. Critical Habitat includes riparian areas that provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

The 1992-1996 5-year average annual escapement for this ESU was about 700. Historical estimates indicate run sizes of a few thousand sockeye salmon in 1926, with a peak recorded harvest of nearly 18,000 in 1949. Estimates indicate that recent abundance is substantially below the historical abundance range for this ESU. Declines are likely a result of a contribution of factors, possibly including introduced species, predation, loss of tributary populations, decline in quality of beach spawning habitat, temporarily unfavorable oceanic conditions, excessive historical harvests, and introduced diseases.

Chinook Salmon

The following summary of general life history and ecology is taken from the Federal Register (63 Fed. Reg. 11481; 1998). Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous and semelparous. This means that as adults, they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female chinook may deposit eggs in four to five "nesting pockets" within a single redd. After laying eggs in a redd, adult chinook will guard the redd from four to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Stream flow, gravel quality, and silt load all significantly influence the survival of developing chinook salmon eggs. Juvenile chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among chinook salmon two distinct races have evolved. One race, described as a "stream-type" chinook, is found most commonly in headwater streams. Steam-type chinook salmon have a longer freshwater residency, and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the "ocean-type" chinook, which is commonly found in coastal steams in North America. Ocean-type chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile steam- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of many watersheds.
Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are, therefore, able to move offshore relatively quickly.

Coast wide, chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and steam-type chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one's origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal steam.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Early researchers recorded the existence of different temporal "runs" or modes in the migration of chinook salmon from the ocean to freshwater. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur. Alaskan and Columbia River stocks of chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

Physical and chemical habitat characteristics for chinook salmon, in general are as follows:

- Temperatures for optimal egg incubation are 5.0-14.4 ^{o}C.
- Upper lethal limit is 25.1 ^{o}C, but may be lower depending on other water quality factors.

- Dissolved oxygen for successful egg development in redds is ≥ 5.0 mg/l, and water temperatures of 4-14 ^{o}C.
- Freshwater juveniles avoid water with ≤ 4.5 mg/l dissolved oxygen at 20 ^{o}C.
- Migrating adults will pass through water with dissolved oxygen levels as low as 3.5-4.0 mg/l. Excessive silt loads (>4,000 mg/l) may halt chinook salmon movements or migrations. Silt can also hinder fry emergence, and limit benthic invertebrate production. Low pH decreases egg and alevin (larval stage dependent on yolk sac as food) survival.

<u>Snake River Fall Chinook Salmon</u>

Snake River fall chinook salmon were listed as threatened in 1992 (59 Fed. Reg. 66786; 1994). An Emergency Rule (59 Fed. Reg. 54840; 1994) proposing to reclassify Snake River chinook from threatened to endangered, was published in November 1994, but expired on May 1995. Critical habitat for the Snake River fall chinook salmon was designated in December 1993 (58 Fed. Reg. 68543; 1993) and modified in March 1998 (63 Fed. Reg. 11515; 1998) to include the Deschutes River. The following summary is taken from information in these Federal Register notices.

A 1995 status review found that the Deschutes River fall-run chinook salmon population should be considered part of the Snake River fall-run ESU. Populations from Deschutes River and the Marion Drain (tributary of the Yakima River) show a greater genetic affinity to Snake River ESU fall chinook than to the Upper Columbia River summer/fall-run chinook (63 Fed. Reg. 11490; 1998). The designated critical habitat (63 Fed. Reg. 11515; 1998) includes all river reaches assessable to chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded are areas above specific dams identified in Table 17 of the Federal Register (63 Fed. Reg. 11519; 1998) or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management. The continued straying by non-native hatchery fish into natural production areas is an additional source of risk. Assessing extinction risk to the newly-configured ESU is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations. The relatively recent extirpation of fall-run chinook in the John Day, Umatilla, and Walla Walla Rivers is also a factor in assessing the risk to the overall ESU. Long-term trends in abundance for specific tributary systems are mixed. NMFS concluded that the ESU as a whole is likely to become an endangered species within the foreseeable future, in spite of the relative health of the Deschutes River population.

See the third paragraph under Snake River spring/summer chinook salmon for life history comparisons between fall and spring/summer chinook salmon. Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon natural spawning is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon and Tucannon Rivers. Fall chinook salmon generally spawn from October through November and fry emerge from March through April.

Downstream migration generally begins within several weeks of emergence with juveniles rearing in backwaters and shallow water areas through mid-summer prior to smolting and migration. Peak migration in the Brownlee-Oxbow Dam reach of the Snake River occurs from April through the middle of May. Juveniles will spend one to four years in the Pacific Ocean before beginning their spawning migration. Chinook salmon fry tend to linger in the lower Columbia River and may spend a considerable portion of their first year in the estuary. For detailed information on the Snake River fall chinook salmon, see the Federal Register (56 Fed. Reg. 29542;1991).

Elevated water temperatures are thought to preclude returning of fall chinook salmon in the Snake River after early to mid-July. The preferred temperature range for chinook salmon has been variously described as 12.2-13.9 ^{o}C, 10-15.6 ^{o}C, or 13-18 ^{o}C. Summer temperatures in the Snake River substantially exceed the upper limits of this range.

No reliable historic estimates of abundance are available for Snake River fall chinook salmon. Estimated returns of Snake River fall chinook salmon declined from 72,000 annually between 1938 and 1949, to 29,000 from 1950 through. Estimated returns of naturally produced adults form 1985 through 1993 range from 114 to 742 fish.

Snake River Spring/Summer Chinook Salmon

Snake River spring/summer chinook salmon were listed as threatened in 1994 (59 Fed. Reg. 66786; 1994). The following summary information is from this Federal Register notice.
This Evolutionarily Significant Unit (ESU) was listed as threatened in April 1992 and was changed to a proposed endangered status in December 1994. The November 1994 Emergency Rule (59 Fed. Reg. 54840; 1994), reclassifying Snake River chinook from threatened to endangered, expired in May 1995. The critical habitat for the Snake River spring/summer chinook salmon was designated in December 1993 (58 Fed. Reg. 68543; 1993). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to

Snake River spring/summer chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam).

This information is taken from the Federal Register (56 Fed. Reg. 29544; 1991). Historically, it is estimated that 44 percent of the combined Columbia River spring/summer chinook salmon returning adults entered the Salmon River. Since the 1960s, counts at Snake River dams have declined considerably. Snake River redd counts in index areas provide the best indicator of trends and status of the wild spring/summer chinook population. The abundance of wild Snake River spring/summer chinook has declined more at the mouth of the Columbia River than the redd trends indicate. Although pre-1991 data suggest several thousand wild spring/summer chinook salmon return to the Snake River each year, these fish are thinly spread over a large and complex river system.

In general, the habitats utilized for spawning and early juvenile rearing are different among the three chinook salmon forms (spring, summer, and fall). In both the Columbia and Snake Rivers, spring chinook salmon tend to use small, higher elevation streams (headwaters), and fall chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer chinook are more variable in their spawning habitats; in the Snake river, they inhabit small, high elevation tributaries typical of spring chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring chinook salmon migrate swiftly to sea as yearling smolts, and fall chinook salmon move seaward slowly as subyearlings. Summer chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" chinook for seaward migrating subyearlings and as "stream-type" chinook for the yearling migrants.

Life history information clearly indicates a strong affinity between summer- and fall-run fish in the upper Columbia River, and between spring- and summer-run fish in the Snake River. Genetic data support the hypothesis that these affinities correspond to ancestral relationships. The relationship between Snake River spring and summer chinook salmon is more complex and is not discussed here.

The present range of spawning and rearing habitat for naturally-spawned Snake River spring/summer chinook salmon is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon sub-basins. Most Snake River spring/summer chinook salmon enter individual sub-basins from May through September. Juvenile Snake River spring/summer chinook salmon emerge from spawning gravels from February through June. Typically, after rearing in their nursery streams for about one year, smolts begin migrating seaward in April through May. After reaching the mouth of the Columbia River, spring/summer chinook salmon probably inhabit near shore areas before beginning their northeast Pacific Ocean migration, which lasts two to three years. For detailed information on the life history and stock status of Snake River spring/summer chinook salmon, see the Federal Register (56 Fed. Reg. 29542; 1991).

The number of wild adult Snake River spring/summer chinook salmon in the late 1800s was estimated to be more than 1.5 million fish annually. By the 1950s, the population had declined to an estimated 125,000 adults. Escapement estimates indicate that the population continued to decline through the 1970s. Redd count data also show that the populations continued to decline through about 1980.

The Snake River spring/summer chinook salmon ESU, the distinct population segment listed under the Act , consists of 39 local spawning populations (sub-populations) spread over a large geographic area. The number of fish returning to a given subpopulation would, therefore, be much less than the total run size.

Based on recent trends in redd counts in major tributaries of the Snake River, many sub-populations could be at critically low levels. Sub-populations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River basins are at particularly high risk. Both demographic and genetic risks would be of concern for such sub-populations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates.

Upper Columbia River Spring-Run Chinook Salmon

Upper Columbia River spring-run chinook salmon were listed as endangered in March 1999 (64 Fed. Reg. 14308; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11489; 1998).

This ESU includes stream-type chinook salmon spawning above Rock Island Dam - that is, those in the Wenatchee, Entiat, and Methow Rivers. All chinook salmon in the Okanogan River are apparently ocean-type and are considered part of the Upper Columbia River summer- and fall-run ESU. Critical habitat designation is found in the Federal Register (63 Fed. Reg. 11515; 1998; 65 Fed. Reg. 7774; 2000). Critical habitat includes all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clapsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are areas above Chief Joseph Dam, areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years), and all Indian lands. Also included are all riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

This ESU was first identified as the Mid-Columbia River summer/fall chinook salmon ESU but a later determination concluded this ESU's boundaries do not extend downstream from the Snake River. The ESU status of the Marion Drain population from the Yakima River is still unresolved.

Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Artificial propagation efforts have had a significant impact on spring-run populations in this ESU, either through hatchery-based enhancement or the extensive trapping and transportation. Harvest rates are low for this ESU, with very low ocean and moderate instream harvest. Previous assessments of stocks within this ESU have identified several as being at risk or of concern. Due to lack of information on chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance of this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring chinook salmon in this ESU have become extinct, and almost all remaining naturally-spawning populations have fewer than 100 spawners. In addition to extremely small population sizes, both recent and long-term trends in abundance are downward, some extremely so. NMFS concluded that chinook salmon in this ESU are in danger of extinction.

Chinook salmon from this ESU primarily emigrate to the ocean as subyearlings but mature at an older age than ocean-type chinook salmon in the Lower Columbia and Snake Rivers. Furthermore, a greater proportion of tag recoveries for this ESU occur in the Alaskan coastal fishery than is the case for Snake River fish. The status review for Snake River fall chinook salmon also identified genetic and environmental differences between the Columbia and Snake rivers. Substantial life history and genetic differences distinguish fish in this ESU from stream-type spring chinook salmon from the upper-Columbia River.

The ESU boundaries fall within part of the Columbia Basin Ecoregion. The areas is generally dry and relies on Cascade Range snowmelt for peak spring flows. Historically, this ESU likely extended farther upstream; spawning habitat was compressed down-river following construction of Grand Coulee Dam.

Lower Columbia River Chinook Salmon, All Runs:

In March 1999, NMFS listed several chinook salmon ESUs in the Lower Columbia River as threatened under the Act (64 Fed. Reg. 14308; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11488; 1998).

Lower Columbia River spring-run chinook are listed as threatened. This ESU includes all naturally spawned chinook populations from the mouth of the Columbia river to the crest of the Cascade Range, excluding populations above Willamette Falls. Critical habitat is designated in the Federal Register (63 Fed. Reg. 11515; 1998; 65 Fed. Reg. 7774; 2000). It includes all river reaches accessible to chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Dalles Dam; with the usual exclusions, including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. The loss of fitness and diversity within the ESU is an important concern.

Harvest rates on fall-run stocks are moderately high, with an average total exploitation rate of 65 percent. Harvest rates are somewhat lower for spring-run stocks, with estimates for the Lewis River totaling 50 percent. Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. There have been at least six documented extinctions of populations in the ESU, and it is possible that extirpation of other native population has occurred but has been masked by the presence of naturally spawning hatchery fish. NMFS concludes that chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

Upper Willamette River Spring-Run Chinook Salmon

Upper Willamette River spring-run chinook salmon were listed as threatened in March 1999 (64 Fed. Reg. 14308; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11489; 1998).

This ESU includes naturally spawned spring-run chinook salmon populations above Willamette Falls. Fall chinook above Willamette Falls are introduced and although they are naturally spawning, they are not considered a population for purposes of defining this ESU. Critical habitat is designated in the Federal Register (63 Fed. Reg. 11515; 1998; 65 Fed. Reg. 7774; 2000). In addition to the area of the Willamette River and its tributaries above the Falls, also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon, with the usual exclusions regarding specific dams, longstanding barriers, and Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

While the abundance of Willamette River spring chinook salmon has been relatively stable over the long term, and there is evidence of some natural production, it is apparent that at present natural production and harvest levels the natural population is not replacing itself. With natural production accounting for only one-third of the natural spawning escapement, it is questionable whether natural spawners would be capable of replacing themselves even in the absence of fisheries. The introduction of fall-run chinook into the basin and laddering of Willamette Falls have increased the potential for genetic introgression between wild spring- and hatchery fall-run chinook. Habitat blockage and degradation are significant problems in this ESU. Another concern for this ESU is that commercial and recreational harvests are high relative to the apparent productivity of natural populations. Recent escapement is less than 5,000 fish and been declining sharply. NMFS concludes that chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

Historic, naturally spawned populations in this ESU have an unusual life history that shares features of both the stream and ocean types. Scale analysis of returning fish indicate a predominantly yearling smolt life-history and maturity at four years of age, but these data are primarily from hatchery fish and may not accurately reflect patterns for the natural fish. Young-of-year smolts have been found to contribute to the returning three year-old year class. The ocean distribution is consistent with an ocean-type life history, and tag recoveries occur in considerable numbers in the Alaskan and British Columbian coastal fisheries. Intra-basin transfers have contributed to the homogenization of Willamette River spring chinook stocks; however, Willamette River spring chinook remain one of the most genetically distinctive groups of chinook salmon in the Columbia River Basin.

The geography and ecology of the Willamette Valley is considerably different from surrounding areas. Historically, the Willamette Falls offered a narrow temporal window for upriver migration, which may have promoted isolation from other Columbia River stocks.

<u>Puget Sound Chinook Salmon</u>

Puget Sound chinook salmon were listed as threatened in March 1999 (64 Fed. Reg. 14308; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11488: 1998).

This ESU encompasses all naturally spawned spring, summer and fall runs of chinook salmon in the Puget Sound region from the North Fork Nooksak River to the Elwha River on the Olympic Peninsula, inclusive. Chinook salmon in this ESU all exhibit an ocean-type life history. Although some spring chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns. The boundaries of the Puget Sound ESU correspond generally with the boundaries of the Puget Lowland Ecoregion. The Elwha River, which is in the Coastal Ecoregion, is the only system in this ESU which lies outside the Puget Sound Ecoregion.

Designated Critical Habitat (65 Fed. Reg. 7777; 2000) includes all marine, estuarine and river reaches accessible to listed chinook salmon in Puget Sound. Puget Sound marine areas include South Sound, Hood Canal, and North Sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait, and the Strait of Juan de Fuca to a straight line extending north from the west end of Freshwater Bay, inclusive. Excluded are areas above specific dams as identified or above longstanding naturally impassable barriers (i.e. natural waterfalls in existence for at least several hundred years). Critical habitat includes riparian areas that provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambed stability, and input of large woody debris or organic matter.

Overall abundance of chinook salmon in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high. Both long- and short-term trends in abundance are predominantly downward, and several populations are exhibiting severe short-term declines. Spring chinook salmon populations throughout this ESU are all depressed.

Habitat throughout this ESU has been blocked or degraded. In general, upper tributaries have been impacted by forest practices and lower tributaries and mainstem rivers have been impacted by agriculture and/or urbanization.

The preponderance of hatchery production throughout the ESU may mask trends in natural populations and makes it difficult to determine whether they are self-sustaining. Overall, the pervasive use of Green River stock throughout much of the extensive hatchery network that exists in this ESU may reduce the genetic diversity and fitness of naturally spawning populations.

Harvest impacts on Puget Sound chinook salmon stocks are quite high. NMFS concluded that chinook salmon in this ESU are not presently in danger of extinction, but they are likely to become endangered in the foreseeable future.

<u>Columbia River Chum Salmon</u>

Columbia River chum salmon are listed as threatened (64 Fed. Reg. 14508; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11773; 1998). Chum salmon in the Columbia River ESU spawn in tributaries to the lower Columbia River in Washington and Oregon.

Critical habitat was designated in the Federal Register (63 Fed. Reg. 11792; 1998; 65 Fed. Reg. 7774; 2000). Designated critical habitat consists of the water and substrate of estuarine and riverine reaches in specific hydrologic units and counties. It also includes those riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. Columbia River chum salmon critical habitat designation includes all accessible reaches in the Columbia River downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. It does not include Indian lands. Accessible reaches are those within the historical range of the ESUs that can be occupied by any life stage of chum salmon.

Life history information specific to the above ESU is not available. The chum salmon or dog salmon is the third most abundant salmon species in the Pacific Northwest. Spawning for chum salmon adults may take place just at the head of tide waters similar to pink salmon (*O. gorbuscha*), however unlike pinks, chum also migrate upriver to spawn. Spawning occurs from October through December. Most adult females construct their redds near saltwater and are territorially aggressive; therefore, females may "miss out" on male spawners. Because of the location of most redds in lower rivers, an embryo mortality of 70 - 90 percent is possible due to siltation and decreased dissolved oxygen transfer. Chum salmon benefit from high quality habitat conditions in lower rivers and estuaries.

After emergence, fry do not rear in freshwater. Chum salmon fry migrate immediately, at night, to the estuary for rearing. Out-migration is March through June. Juveniles remain near the seashore during July and August. Juveniles spend from just half a year to four years at sea.

<u>Hood Canal Summer-Run Chum Salmon</u>

Hood Canal summer-run chum salmon are listed as threatened (64 Fed.Reg. 14508; 1999). The following life history information is taken from the Federal Register (63 Fed. Reg. 11774; 1998). This ESU includes summer-run chum salmon populations in Hood Canal; Puget Sound; and in Discovery, Sequim and Dungeness Bays on the Strait of Juan de Fuca.

Designated critical habitat (65 Fed. Reg. 7774: 2000) includes all river reaches accessible to listed summer-run chum salmon (including tributaries) draining into Hood Canal as well as Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. It includes estuarine/marine areas adjacent to the basins within the range of the ESU as well as the Hood Canal waterway, and areas of Admiralty Inlet and the Strait of Juan de Fuca. Excluded are areas above Cushman Dam or above longstanding naturally impassable barriers. It also includes the adjacent riparian areas that provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Although summer-run chum salmon in this ESU have experienced a steady decline over the past 30 years, escapement in 1995-96 increased dramatically in some streams. Spawning escapement of summer-run chum salmon in Hood Canal (excluding the Union River) numbered over 40,000 fish in 1968, but was reduced to only 173 fish in 1989. In 1991, only 7 of 12 streams that historically contained spawning runs of these fish still had escapements. In 1995-96 escapement increased to more than 21,000 fish in Northern Hood Canal, mostly on the west side. Population levels of early-run chum in the Strait of Juan de Fuca are at very low population levels. The overall trend in the Strait populations is one of continued decline. In 1994, of 12 streams in Hood Canal identified by petitioners as recently supporting spawning populations of summer-run chum salmon, 5 may have already become extinct, 6 of the remaining 7 showed strong downward trends in abundance, and all were at low levels of abundance.

See the discussion for Columbia River chum salmon for a life history discussion.

The present depressed condition is the result of several longstanding, human-induced factors (e.g., habitat degradation, water diversions, harvest, and artificial propagation) that serve to exacerbate the adverse effects of natural factors (e.g., competition and predation) or environmental variability from such factors as drought and poor ocean conditions.

Steelhead

The following summary of general life history and ecology is taken from the Federal Register (63 Fed. Reg. 11797; 1998). Steelhead exhibit one of the most complex life histories of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as “rainbow” or “redband” trout, while anadromous life forms are termed “steelhead”.

Steelhead typically migrate to marine waters after spending two years in freshwater. They then reside in marine waters for two to three years prior to returning to their natal stream to spawn as 4- or 5- year-olds. Depending on water temperature, steelhead eggs may incubate in redds for one and one half to four months before hatching as alevins. Following yolk sac absorption, alevins emerge from the gravel as young juveniles (fry) and begin actively feeding. Juveniles rear in freshwater from one to four years, then migrate to the ocean as smolts.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed “stream maturing” and “ocean maturing”. Stream maturing steelhead return to freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry as either summer or winter steelhead.

Two major genetic groups or “subspecies” of steelhead occur on the west coast of the United States: a coastal group and an inland group, separated on the Fraser and Columbia River Basins by the Cascade crest.   Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California, as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally-reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams.

Factors contributing to the decline of specific steelhead ESUs are discussed under each ESU. General information for west coast steelhead is summarized here. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Washington and Oregon’s wetlands are estimated to have diminished by one-third. Loss of habitat complexity as seen in the decrease of abundance of large, deep pools due to sedimentation and loss of pool-forming structures has also adversely affected west coast steelhead.

Steelhead are not generally targeted in commercial fisheries but do support an important recreational fishery throughout their range. A particular problem occurs in the main stem of the Columbia River where listed steelhead from the Middle Columbia River ESU are subject to the same fisheries as unlisted, hatchery-produced steelhead, chinook and coho salmon. Infectious disease and predation also take their toll on steelhead. Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous river systems. Federal and state land management practices have not been effective in stemming the decline in west coast steelhead.

Snake River Basin Steelhead

This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. A final listing status of threatened was issued in August 1997 (62 Fed. Reg. 43937; 1997) for the spawning range upstream from the confluence with the Columbia River. Critical habitat was proposed in the Federal Register (64 Fed. Reg. 5740; 1999) and finalized (65 Fed. Reg. 7775; 2000). It is designated to include all river reaches accessible to listed steelhead in the Snake River and tributaries in Idaho, Oregon, and Washington. Also included are river reaches and estuarine areas in the Columiba River from a straight line connecting the west end of the Clapsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River in Washington with the usual exclusions including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. The following information is taken from the Federal Register (62 Fed. Reg. 43937; 1997; 63 Fed. Reg. 11482; 1998).

The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

Snake River Basin (SRB) steelhead all defined as “B-run” steelhead. Prior to Ice Harbor Dam completion in 1962, there were no counts of Snake River basin naturally spawned steelhead. From 1949 to 1971 counts averaged about 40,000 steelhead for the Clearwater River. At Ice Harbor Dam, counts averaged approximately 70,000 until 1970. The natural component for steelhead escapements above Lower Granite Dam was about 9400 (2400 B-run) from 1990-1994. SRB steelhead recently suffered severe declines in abundance relative to historical levels. Low run sizes over the last 10 years are most pronounced for naturally produced steelhead. The drop in parr densities characterizes many river basins in this region as being underseeded relative to the carrying capacity of streams. Declines in abundance have been particularly serious for B-run steelhead, increasing the risk that some of the life history diversity may be lost from steelhead in this ESU.

Interactions between hatchery and natural SRB steelhead are of concern because many of the hatcheries use composite stocks that have been domesticated over a long period of time. The primary indicator of risk to the ESU is declining abundance throughout the region.

SRB steelhead are summer steelhead, as are most inland steelhead, and comprise two groups, A-run and B-run, based on migration timing, ocean-age, and adult size. SRB steelhead enter freshwater from June to October and spawn in the following spring from March to May. A-run steelhead are thought to be predominately 1-ocean (one year at sea), while B-run steelhead are thought to be 2-ocean. SRB steelhead usually smolt at age 2- or 3-years.

The steelhead population from Dworshak National Fish Hatchery is the most divergent single population of inland steelhead based on genetic traits determined by protein electrophoresis; these fish are consistently referred to as B-run.

Similar factors to those affecting other salmonids are contributing to the decline of SRB steelhead. Widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The reduction in habitat capacity resulting from large dams such as the Hells Canyon dam complex and Dworshak Dam is somewhat mitigated by several river basins with fairly good production of natural steelhead runs.

Upper Columbia River Basin Steelhead

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. The geographic area occupied by the ESU forms part of the larger Columbia Basin Ecoregion. Upper Columbia River Basin (UCRB) steelhead were listed as endangered in August 1997 (62 Fed. Reg. 43937; 1997). Critical habitat was proposed (64 Fed. Reg. 5740; 1999) and finalized (65 Fed. Reg. 7775; 2000). It is designated to include all river reaches accessible to listed steelhead in the Columbia River tributaries upstream of the Yakima River, Washington, and downstream of Chief Joseph Dam. Also included are river reaches and estuarine areas in the Columiba River from a straight line connecting the west end of the Clapsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington, with the usual exclusions including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. The following life history information is taken from the Federal Register (62 Fed. Reg. 43937; 1997).

NMFS cites a pre-fishery run size estimate in excess of 5000 adults for tributaries above Rock Island Dam. Runs may have already been depressed by lower Columbia River fisheries at the time of the early estimates (1933-1959). Most of the escapement to naturally spawning habitat within the range of this ESU is to the Wenatchee, Methow and Okanogan Rivers. The Entiat River also has a small spawning run. Steelhead in the Upper Columbia river ESU continue to exhibit low abundances, both in absolute numbers and in relation to numbers of hatchery fish throughout the region. Estimates of natural production of steelhead in the ESU are will below replacement (approximately 0.3:1 adult replacement ratios estimated in the Wenatchee and Entiat Rivers). The proportion of hatchery fish is high in these rivers (65-80 percent) with extensive mixing of hatchery and natural stocks.

Life history characteristics for UCRB steelhead are similar to those of other inland steelhead ESUs. However, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU; this may be associated with the cold stream temperatures. Based on limited data available from adult fish, smolt age in this ESU is dominated by 2-year-olds. Steelhead from the Wenatchee and Entiat Rivers return to freshwater after one year in salt water, whereas Methow River steelhead are primarily 2-ocean resident (i.e., two years in salt water).

In an effort to preserve fish runs affected by Grand Coulee Dam, which blocked fish passage in 1939, all anadromous fish migrating upstream were trapped at Rock Island Dam (river km 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area. Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate sub-basins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown.

Habitat degradation, juvenile and adult mortality in the hydrosystem, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the Upper Columbia River Basin ESU.

Middle Columbia Basin Steelhead

After a comprehensive status review of West Coast steelhead populations in Washington and Oregon, NMFS identified 15 ESUs. In March 1999, Middle Columbia River steelhead were listed as threatened (64 Fed. Reg. 14517; 1999). The middle Columbia area includes tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon, upstream to, and including the Yakima River, in Washington. Steelhead of the Snake River Basin are excluded. Critical habitat was proposed (64 Fed. Reg. 5740; 1999) and finalized (65 Fed. Reg. 7775; 2000). It is designated to include all river reaches accessible to listed steelhead in Columbia River tributaries (except the Snake River) between Mosier Creek in Oregon and the Yakima River in Washington (inclusive). Also included are river reaches and estuarine areas in the Columiba River from a straight line connecting the west end of the Clapsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Yakima River in Washington, with the usual exclusions including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. The following life history information is taken from the Federal Register (63 Fed. Reg. 11797; 1998).

Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU: the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). In addition, NMFS remains concerned about the widespread long- and short-term downward trends in population abundance throughout the ESU.

Genetic differences between inland and coastal steelhead are well established, although some uncertainty remains about the exact geographic boundaries of the two forms in the Columbia River (63 Fed. Reg. 11801; 1998). All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run, inland steelhead. Life history information for steelhead of this ESU indicates that most middle Columbia River steelhead smolt at two years and spend one to two years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering freshwater, where they may remain up to a year before spawning. Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead, whereas most other rivers in this region produce about equal number of both 1- and 2-ocean steelhead.

The recent and dramatic increase in the percentage of hatchery fish in natural escapement in the Deschutes River Basin is a significant risk to natural steelhead in this ESU. Coincident with this increase in the percentage of strays has been a decline in the abundance of native steelhead in the Deschutes River.

Lower Columbia Basin Steelhead

This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon Rivers in Washington. Lower Columbia River steelhead are listed as threatened (63 Fed. Reg. 13347; 1998). Critical habitat was proposed (64 Fed. Reg. 5740; 1999) and finalized (65 Fed. Reg. 7775; 2000). It is designated to include all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River in Oregon with the usual exclusions including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. The following life history information is taken from the Federal Register (63 Fed. Reg. 11482; 1998).

The lower Columbia River has extensive intertidal mud and sand flats and differs substantially from estuaries to the north and south. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast.

Steelhead populations are at low abundance relative to historical levels, placing this ESU at risk due to random fluctuations in genetic and demographic parameters that are characteristic of small populations. There have been almost universal, and in many cases dramatic, declines in steelhead abundance since the mid-1980s in both winter- and summer-runs. Genetic mixing with hatchery stocks have greatly diluted the integrity of native steelhead in the ESU. NMFS is unable to identify any natural populations of steelhead in the ESU that could be considered “healthy”.

Steelhead populations in this ESU are of the coastal genetic group, and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead in this ESU to be distinct from steelhead in the upper Willamette River and coastal streams in Oregon and Washington. Washington Department of Fish and Wildlife data show genetic affinity between the Kalama, Wind, and Washougal River steelhead. These data show differentiation between the Lower

Columbia River ESU and the Southwest Washington and Middle Columbia River Basin ESUs. The Lower Columbia ESU is composed of winter steelhead and summer steelhead.

Habitat loss, hatchery steelhead introgression, and harvest are major contributors to the decline the steelhead in this ESU. Details on factors contributing to the decline of west coast steelhead are discussed above.

Upper Willamette River Steelhead

In March 1999, the Upper Willamette River steelhead were listed as threatened (64 Fed. Reg. 14517; 1999). Critical habitat was proposed (64 Fed. Reg. 5740; 1999) and finalized (65 Fed. Reg. 7775; 2000). It is designated to include all river reaches accessible to listed steelhead in the Willamette River and its tributaries above Willamette Falls upstream to, and including, the Calapooia River. Also included are river reaches and estuarine areas in the Columiba River from a straight line connecting the west end of the Clapsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to, and including, the Willamette River in Oregon with the usual exclusions including Indian lands. It includes riparian areas which provide the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. The following life history information is taken from the Federal Register (63 Fed. Reg. 11797; 1998).

This coastal ESU occupies the Willamette River and its tributaries, upstream from Willamette Falls. The Willamette River Basin is geographically complex. In addition to its connection to the Columbia River, the Willamette River historically has had connections with coastal basins through stream capture and headwater transfer events.

Steelhead from the upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring chinook salmon occurred historically above the falls, but summer steelhead, fall chinook salmon, and coho salmon did not.

Steelhead in the Upper Willamette ESU are distributed in a few, relatively small, natural populations. Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000-20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of the last five years (to 1998) has been below 4,300 fish, and the run in 1995 was the lowest in 30 years. The low abundance, coupled with potential risks associated with interactions between naturally spawned steelhead and hatchery stocks is of great concern to NMFS.

The native steelhead of this basin are late-migrating winter steelhead, entering freshwater primarily in March and April, whereas most other populations of west coast winter steelhead enter freshwater beginning in November or December. As early as 1885, fish ladders were constructed at Willamette Falls to aid the passage of anadromous fish. As technology improved, the ladders were modified and rebuilt, most recently in 1971. These fishways facilitated successful introduction of Skamania stock summer steelhead and early-migrating Big Creek stock winter steelhead to the upper basin. Another effort to expand the steelhead production in the upper Willamette River was the stocking of native steelhead in tributaries not historically used by that species. Native steelhead primarily used tributaries on the east side of the basin, with cutthroat trout predominating in streams draining the west side of the basin.

Nonanadromous steelhead are known to occupy the Upper Willamette River Basin; however, most of these nonanadromous populations occur above natural and man-made barriers. Historically, spawning by Upper Willamette River steelhead was concentrated in the North and Middle Santiam River Basins. These areas are now largely blocked to fish passage by dams, and steelhead spawning is distributed throughout more of the Upper Willamette River Basin than in the past. Due to introductions of non-native steelhead stocks and transplantation of native stocks within the basin, it is difficult to formulate a clear picture of the present distribution of native Upper Willamette River steelhead, and their relationship to nonanadromous and possibly residualized steelhead within the basin.

Southwest Washington/Lower Columbia River Cutthroat Trout

Southwest Washington/Lower Columbia River cutthroat trout were proposed as endangered in April 1999 (64 Fed.Reg. 16397; 1999). The ESU consists of coastal cutthroat trout populations in southwestern Washington and the Columbia River, excluding the Willamette River above Willamette Falls. In this proposed ESU, only naturally spawned cutthroat trout are proposed for listing. Prior to the final listing determination, NMFS and USFWS will examine the relationship between hatchery and naturally spawned populations of cutthroat trout, and populations of cutthroat trout above barriers to assess whether any of these populations warrant listing. This may result in the inclusion of specific hatchery populations or populations above barriers as part of the listed ESU in the final listing determination.

The southwestern Washington-lower Columbia River region historically supported healthy, highly productive coastal cutthroat trout populations. Coastal cutthroat trout, especially, the freshwater forms, may still be well distributed in most river basins in this geographic region, although probably in lower numbers relative to historical populations sizes. However, severe habitat degradation throughout the lower Columbia River areas has contributed to dramatic declines in anadromous coastal cutthroat trout populations and two near extinctions of anadromous runs in the Hood and Sandy Rivers. The Services remain concerned about the extremely low populations sizes of anadromous coastal cutthroat trout in lower Columbia River streams, indicated by low incidental catch of coastal cutthroat trout in salmon and steelhead recreational fisheries, and by low trap counts in a number of tributaries throughout the region. The general life history forms are similar to those described for the Umpqua Cutthroat trout below.

Numbers of anadromous adults and outmigrating smolts in the southwestern Washington portion of this ESU are all declining. Returns of both naturally and hatchery produced anadromous coastal cutthroat trout in almost all lower Columbia River streams have declined markedly over the last 10 to 15 years. Serious declines in the anadromous form have occurred throughout the lower Columbia River, and it has been nearly extirpated in at least two rivers on the Oregon side of the basin. Indeed, the only anadromous coastal cutthroat population in the lower Columbia River to show increased abundance over the last 10 years is the North Fork Toutle River population, which is thought to be recovering from the effects of the Mt. Saint Helens eruption in 1980.

Factors for the decline of this subspecies include: habitat degradation as a result of logging; recreational fishing; predation by marine mammals, birds, and native and non-native fish species; adverse environmental conditions resulting from natural factors such as droughts, floods, and poor ocean conditions; non-point and point pollution source pollution caused by agriculture and urban development; disease outbreaks caused by hatchery introductions and warm water temperatures; mortality resulting from unscreened irrigation inlets; competition in estuaries between native and hatchery cutthroat trout; cumulative loss and alteration of estuarine areas; and loss of habitat caused by the construction of dams.

<u>Southwest Washington/Lower Columbia River Cutthroat Trout (*Oncorhynchus clarkii clarkii)*</u>

Southwest Washington-Lower Columbia River cutthroat trout were proposed as threatened in April 1999 (64 Fed. Reg. 16397; 1999). A 6-month extension on the listing has been approved and the species will be under review until October 5, 2000. The distinct population segment (DPS) consists of coastal cutthroat trout populations in southwestern Washington and the Columbia River downstream of Willamette Falls. In this proposed DPS, only naturally spawned cutthroat trout are proposed for listing. Prior to the final listing determination, the Service will examine the relationship between hatchery and naturally spawned populations of cutthroat trout, and populations of cutthroat trout above barriers to assess whether any of these populations warrant listing. This may result in the inclusion of specific hatchery populations or populations above barriers as part of the listed DPS in the final listing determination.

Factors contributing to the decline of anadromous cutthroat trout in the southwest Washington-Lower Columbia River DPS include: habitat degradation from land management activities such as logging and road construction; recreational, tribal and commercial fishing; predation by marine mammals, birds, and native and non-native fish species; adverse environmental conditions resulting from natural factors such as droughts, floods, and poor ocean conditions; non-point and point pollution source pollution caused by agriculture and urban development; disease outbreaks caused by hatchery introductions and warm water temperatures; mortality resulting from unscreened irrigation and drainage systems; competition between native cutthroat and hatchery-produced salmon and trout; cumulative loss and alteration of estuarine areas; and loss of habitat caused by the construction of dams.

The southwestern Washington-Lower Columbia River region historically supported healthy, highly productive coastal cutthroat trout populations. Sea-run coastal cutthroat trout on the Washington side of the lower Columbia were believed to have existed in tributaries as far up as the Klickitat River (Bryant 1949) but are currently confined downstream of Bonneville Dam. Cutthroat trout population trend data is limited primarily to available harvest information (i.e. creel census), incidental catch records, and juvenile abundance data from smolt trapping and electrofishing operations conducted for salmon and steelhead. Numbers of anadromous adults and outmigrating smolts in the southwestern Washington-Lower Columbia River DPS are all showing significant declines (Melcher and Watts 1995; Leider 1997). Returns of both naturally and hatchery produced anadromous coastal cutthroat trout in almost all of the lower Columbia River streams have declined markedly over the last 10 to 15 years and it has been nearly extirpated in at least two rivers on the Oregon side of the basin. The catch of sea-run cutthroat trout in the recreational salmon and steelhead fishery on the lower river dropped from an average of around 4,200 fish between 1975 and 1985 to less than 500 from 1976 to 1995 (Leider 1997). A similar trend has was reported for returning adults during the same time periods, based on counts at the Kalama Falls hatchery (Hulett et al. 1995). The only anadromous coastal cutthroat population in the lower Columbia River to show increased abundance over the last 10 years is the North Fork Toutle River population, which is thought to be recovering from the effects of the Mount St. Helens eruption in 1980.

In comparison to the poor condition of the coastal cutthroat stocks in the lower Columbia, the streams containing sea-run cutthroat trout in the Grays Harbor, Willapa Bay and along the southern Washington coast are faring a bit better, likely due to the availability of the two large estuaries. Sea-run cutthroat trout along the southern coast do not appear to migrate far from their respective estuaries and data for the lower Chehalis River and streams entering Willapa Bay indicate that the populations are low but relatively stable. However, the populations of sea-run cutthroat trout in the upper Chehalis River watershed (e.g. above the confluence of the Skookumchuck River) and other headwater areas in southwest Washington appear to be depressed. This likely is due to the cumulative effects of intensive land management activities in the upper basins and fishing pressure. Approximately 37,000 smolts were released between 1982 and 1994 into nine coastal streams, representing almost 14% of the statewide production of sea-run cutthroat for that time period. The vast majority of hatchery produced cutthroat trout are released into the lower Columbia River.

The resident freshwater form of coastal cutthroat trout, may still be well distributed in most river basins in this geographic region, although probably in lower numbers relative to historical populations sizes. Because of their tendency to reside in small streams and headwater areas, cutthroat trout are highly vulnerable to changes in freshwater habitat.

Coastal cutthroat trout occur along the coast of North America from Humboldt Bay,
California to Prince William Sound, Alaska. This species occurs inland to the crest of the
Cascade Mountain Range in Washington and Oregon, and to the crest of the Coast Range in
British Columbia and Alaska (Trotter 1989).

Cutthroat trout evolved to exploit habitats least preferred by other salmonid species. There are three basic life history forms that occur with coastal cutthroat trout, including an anadromous (sea-run) form, a potamodromous form that includes both stream-dwelling (fluvial) and lake dwelling (adfluvial) populations , and a non-migratory (resident) form found in small streams and headwater tributaries (Trotter 1989).
Sea-run coastal cutthroat trout spawn in low or gentle gradient areas of the mainstem or tributaries of small to moderate size streams systems. Spawning periods extend from December through May with peak spawning periods in February in Washington, Oregon and southern British Columbia (Trotter 1989). Emergence from the gravel can occur from March through June, with a peak occurring around mid April (Trotter 1989). After emergence, cutthroat trout need nursery and rearing habitat with protective cover and low velocity water (Behnke 1992). These habitats occur along stream margins, side channels, small tributaries and spring seeps.

In the absence of competition, juvenile cutthroat trout are found predominantly in pools and backwater areas downstream or adjacent to faster water (Glova 1987). In systems where juvenile coho and cutthroat trout occur in the same area, interspecies competition is observed. Both species utilize similar habitats during their first year. Because of their earlier emergence from the gravel, juvenile coho salmon tend to be larger and more aggressive and displace the young cutthroat trout into less favorable faster water areas (Glova 1984, 1987; Trotter et al. 1993). The cutthroat trout remain in the riffles until the water temperature drops, which reduces aggression in coho salmon (Trotter 1989). In addition, increasing winter flows will eventually force the cutthroat trout into areas of the stream with lower velocities and more protected environments (Glova and Mason 1976, 1977). Releases of hatchery coho salmon fry into areas with age-0 cutthroat trout has been shown to result in displacement of the native cutthroat into less favorable habitats during their first summer, which may have adverse consequences on the affected populations (Glova 1984, 1987; Trotter et al. 1993).

Sea-run cutthroat trout begin their downstream movement in the winter and spring of their first year (Trotter 1989). The fish may move back up into the tributaries during high water events. Typically, as the fish get larger and older, they move into deeper waters with some form of cover nearby such as undercut banks, large woody debris or overhanging vegetation. These selected areas are often adjacent to fast waters that carry food for the trout to access (Behnke 1992).

Anadromous coastal cutthroat trout have been documented to smolt and migrate to sea from age 1 to age 6 (Leider, referenced in OCAFS 1997), with the majority smolting and migrating at age 2, 3 or 4 (Trotter 1989). Sea-run coastal cutthroat trout can attain a maximum age of 10 years. In Washington and Oregon, seaward migration peaks in mid-May (Trotter 1989). The fish spend approximately 2-5 months in the bays, estuaries and along the coast before returning to the rivers as the winter months approach (Behnke 1992). Sea-run coastal cutthroat trout may complete this seaward migration pattern twice before returning to their natal streams to spawn (Trotter 1989). While in salt water, they feed predominantly on crustaceans and fish, compared to the freshwater diet which consists primarily of aquatic insects, as well as other fish species (Behnke 1992).

The potamodromous form of coastal cutthroat trout includes both stream (fluvial) and lake dwelling (adfluvial) life history patterns. Fluvial coastal cutthroat trout have the same migratory patterns as the sea-run trout, but mature in the mainstem river systems rather than the marine environment (Trotter 1989; Leider 1997). Fluvial cutthroat trout populations are typically located above natural barriers to upstream migration for anadromous trout, such as Willamette and Snoqualmie Falls, and utilize similar spawning habitats (Trotter 1989). In areas where fluvial cutthroat trout occur in sympatry with sea-run populations, the stream dwelling populations move into the mainstem river systems as the sea-run populations are migrating to the marine environment, thus reducing competition (Tomasson 1978). In systems where rainbow trout, char, or other salmonid species are present, there is a tendency for habitat partitioning and competition to occur between the species (Leider 1997).

The lake dwelling forms of coastal cutthroat trout exhibit life history patterns similar to the sea-run forms but their spawning periods occur in late winter or spring versus fall and early winter (Trotter 1989). Lake dwelling coastal cutthroat trout mature at around ages 3 to 4 (Pierce 1984), and these fish spawn every year thereafter. The lake dwelling forms exhibit both inlet and outlet spawning populations. After emergence from the gravel, the trout spend 1 to 3 years in tributaries before migrating back to the lakes (Trotter 1989). If lake dwelling coastal cutthroat trout are the only salmonid present in the lake, they use a wide variety of habitats, ranging from shallow to deep water areas (Nielsson and Northcote 1981) and are strongly attracted to areas with cover (Shepherd 1974). They forage in all zones, consuming surface food such as terrestrial insects and floating or emerging aquatic insects, crustacean plankton, small fish, and benthic prey items, with an emphasis on mid-water prey (Nilsson and Northcote 1981)

In lakes where cutthroat trout, rainbow trout, and bull trout/Dolly Varden (char), occur in sympatry, interactive segregation occurs. In these conditions, cutthroat trout are found closer inshore while the rainbow trout and char remain further offshore. Feeding zones are partitioned into these inshore and offshore zones and feeding patterns change. The cutthroat trout, now displaced from the preferred mid-water feeding areas, are restricted to nearshore surface and benthic prey and also exhibit more piscivory than their allopatric counterparts (Trotter 1989; Nilsson and Northcote 1981).

Resident nonmigratory coastal cutthroat trout are found in small headwater streams and exhibit only limited instream movement (Trotter 1989). Wyatt (1959) reported that only 3 percent of the population ever moved more than 200m (600 ft) from their emergence area. Resident cutthroat trout are small, generally not exceeding 150 to 200mm (6-7 in) in length. These fish mature at age 2 to 3 and have a shorter life span, typically living only 3 to 4 years (Wyatt 1959; Nicholas 1978).

After emerging from the gravel, the young resident cutthroat trout move to channel margins, side channels and slow water areas and move to feeding areas in pools towards the end of summer (Moore and Gregory 1988). In winter, they may move downstream to more secure habitats to avoid high water events. In the spring, when water temperatures reach 15°C (59°F), the mature trout move back into the spawning areas. Resident life history forms primarily feed at the head of pools on drift prey (Wilzbach and Hall 1985).

Bull Trout (*Salvelinus confluentus*)

Bull trout in the Columbia River and Klamath Basins were listed as threatened on June 10, 1998 (63 Fed. Reg. 31674; 1998). The Jarbridge population segment was emergency listed on August 11, 1998 and the Coastal Puget Sound and remaining populations in the coterminous United States were listed on November 1, 1999.

Bull trout presently occur in about 45 to 60 percent of their historic range (Quigley and Arbelbide 1997). The remaining distribution of bull trout in the Columbia River basin and Coastal Puget Sound is highly fragmented. Resident bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. Many of these small remnant populations have a low likelihood of long-term persistence (Reiman and McIntyre 1993) and several populations and life history forms of bull trout have been extirpated entirely.

Bull trout are threatened by habitat degradation and fragmentation from past and ongoing land management activities such as mining, timber harvest, road construction and maintenance, dams, water diversions and withdrawals, agriculture, development, and grazing. Bull trout are also threatened by interactions with non-native fishes, such as brook trout (*Salvelinus fontinalis*), with which they hybridize, and numerous introduced species, found in reservoirs, which prey on bull trout or compete for limited resources.

Bull trout, members of the family Salmonidae, are char native to the Pacific Northwest and western Canada. Bull trout historically occurred in major river drainages in the Pacific Northwest from about 41° N to 60° N latitude, extending from northern California to the headwaters of the Yukon River in the Northwestern Territories of Canada (Cavender 1978; Bond 1992). To the west, the species' range includes Puget Sound, various coastal rivers of Washington, British Columbia, and southeast Alaska (Bond 1992; McPhail and Carveth 1992; Leary and Allendorf 1997). In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' range. Bull trout numbers steadily declined after the completion of McCloud and Shasta Dams (Rode 1990). The last confirmed report of a bull trout in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990).

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997).

The Columbia River population segment is composed of 141 sub-populations within the lower, mid, and upper river sections as well as the Snake River drainage. The lower Columbia River includes all tributaries in Oregon and Washington below the confluence of the Snake River. The Service identified 20 sub-populations within nine major tributaries in the lower river, three of which are located in Washington - the Lewis River, White Salmon, and the Walla Walla River basins. Of the 20 sub-populations, thirteen are considered migratory, primarily adfluvial populations which inhabit reservoirs created by dams, and five are at high risk of extirpation.

The mid-Columbia River geographic area includes 16 sub-populations in four major tributaries - the Yakima River, Wenatchee River, Entiat River and the Methow drainage. Bull trout are believed to have been extirpated in 10 streams within the area - Satus Creek, Nile Creek, Orr Creek, the Little Wenatchee River, Napecqua River, Lake Chlan, Okanogan River, Eightmile Creek, South Fork Beaver Creek, and the Hanford Reach of the Columbia River. Within the mid-Columbia River system, bull trout are most abundant in Rimrock Lake (Yakima basin) and Lake Wenatchee. The remaining 14 sub-populations have low numbers and 10 are at risk of extirpation.

The Upper Columbia River geographic area covers all tributaries upstream of Chief Joseph Dam, including the Spokane and the Pend Oreille Rivers in Washington. The remaining DPS is located in Idaho and Montana. Although the upper Columbia River still contains some “strongholds” for bull trout, the species has been extirpated from 64 streams and lakes within this geographic area, including the Kettle River.

The Coastal Puget Sound population segment encompasses all Pacific coast drainages within Washington, including Puget Sound. Within this area, bull trout often occur sympatically with Dolly Varden and several sub-populations exhibit an anadromous life history form. Because the two species are virtually impossible to differentiate visually, the WDFW currently manages bull trout and Dolly Varden together as “native char.” The Service has delineated 34 sub-populations of native char within the Coastal Puget Sound DPS, distributed in five geographic areas - Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound and the trans-boundary area (Canadian border).

Although most native char populations in the northwestern coastal area occur within the relatively protected areas of Olympic National Forest and Park, brook trout have been stocked in many of the high lakes and streams and threaten the bull trout populations from competition and hybridization. The WDFW believes that the Hoh River may have the largest subpopulation on the Washington coast, although their numbers have greatly declined since 1982 (WDFW *in lit.* 1992; WDFW 1997a).

Populations of native char in the southwestern coastal area appear to be low, likely because this represents the southern extent of both coastal bull trout and Dolly Varden. Habitat degradation has contributed to the decline of the species within the Chehalis, Moclips, and Copalis River systems (64 Fed. Reg. 58910; 1999b; WDFW 1997a).

Within the Juan de Fuca geographic area, bull trout occur within the Elwha River, Angeles Basin, and the lower Dungeness River. Large portions of the Dungeness lie outside of the park and have been impacted by past forest and agricultural practices and residential development. Populations of native char in the Elwha River and lower Dungeness/Grey Wolf are considered depressed due to declining numbers, while the status of sub-populations in the upper Dungeness within the Buckhorn Wilderness Area are stable.

Native char populations in the Hood Canal geographic area occur in the Skokomish River basin. Due to the construction of Cushman Dam on the North Fork Skokomish river, bull trout in Cushman Reservoir are isolated and restricted to an adfluvial life history form while fish in the lower river are anadromous. The populations within Cushman Reservoir and the upper North Fork Skokomish River have stabilized since the harvest closure on the reservoir and upper river in 1986 (Brown 1992). However, the South Fork-lower Skokomish River and upper river populations are still considered to be depressed due to low spawner numbers.

Within the Puget Sound geographic area, 15 native char sub-populations occur in nine river basins - the Nisqually River, Puyallup River, Green River, Lake Washington Basin, Snohomish River, Skykomish River, Stillaguamish, Skagit and the Nooksack River systems. The current abundance of native char in the southern Puget Sound is below historic levels and declining (64 Fed. Reg.58910; 1999b and Fred Goetz, U.S. Army Corps of Engineers (COE), pers. Comm. 1994a, b). Historical accounts from southern Puget Sound indicate that anadromous char entered the rivers in "vast numbers" in fall and were harvested until Christmas (Federal Register reference to Suckley and Cooper 1860). There is only one recent record of a char collected in the Nisqually River and only 23 adults have been caught at the Buckley diversion dam on the Puyallup River since 1987 (WDFW 1998a). In the Cedar River, native char are rarely observed and fewer than 10 redds were reported above the Chester Morse Reservoir in 1995 and 1996 (64 Fed. Reg. 58910; 1999b; F. Goetz, pers. comm. 1994a, b). It is questionable if the Sammamish River and Issaquah Creek sub-populations, which have been severely impacted by urbanization and poor water quality, are viable (Williams *et al.* 1975; 64 Fed. Reg. 58910; 1999b).

Water quality, temperatures, and instream habitats in the Skagit, South Fork Sauk, Skykomish River, and other river systems of northern Puget Sound are relatively good and support stronger populations of bull trout than elsewhere in the Puget Sound DPS. All but 5 of the sub-populations of native char in the drainages of the northern Puget Sound region are considered to be strong or stable.

Bull trout exhibit resident and migratory life-history strategies through much of their current range (Rieman and McIntyre 1993). Resident bull trout complete their life cycles in the tributary streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear from 1 to 4 years before migrating to either a lake (adfluvial) or river (fluvial). Anadromous bull trout spawn in tributary streams, with major growth and maturation occurring in the ocean (Fraley and Shepard 1989; Goetz 1989).

Highly migratory, fluvial populations have been eliminated from the largest, most productive river systems across the range. Stream habitat alterations restricting or eliminating bull trout include obstructions to migration, degradation of water quality, especially increasing temperatures and increased amounts of fine sediments, alteration of natural stream flow patterns, and structural modification of stream habitat (such as channelization or removal of cover).

Persistence of migratory life history forms and maintenance or re-establishment of stream migration corridors is crucial to the viability of bull trout populations (Reiman and McIntyre 1993). Migratory bull trout facilitate the interchange of genetic material between populations, ensuring sufficient variability within populations. Migratory forms also provide a mechanism for reestablishing local populations that have been extirpated and are more fecund and larger than smaller non-native brook trout, potentially reducing the risks associated with hybridization (Reiman and McIntyre 1993).

Bull trout have relatively specific habitat requirements compared to other salmonids (Rieman and McIntyre 1993). Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (Oliver 1979; Pratt 1984, 1992; Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Buchanan and Gregory 1997; Rieman et al. 1997; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the necessary habitat requirements for bull trout to successfully spawn and rear, and that these characteristics are not necessarily ubiquitous throughout watersheds in which bull trout occur. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), they should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997). However, while a small fraction of available stream habitat within a drainage or subbasin may be used for spawning and rearing, a much more extensive area may be utilized as foraging habitat, or seasonally as migration corridors to other waters.

Water temperature above 15° C (59° F) is believed to limit bull trout distribution, which partially explains their generally patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995). Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Rieman et al. 1997).

All life history stages of bull trout are closely associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Oliver 1979; Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Pratt 1992; Thomas 1992; Rich 1996; Sexauer and James 1997; Watson and Hillman 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing complex large woody debris in the Bitterroot River drainage, Montana, and suggested that suitable winter habitat may be more restrictive than summer habitat. Maintaining bull trout populations requires high stream channel stability and relatively stable stream flows (Rieman and McIntyre 1993). Several authors have observed highest juvenile densities in streams with complex cover associated with side channels, stream margins, and pools and areas with diverse cobble substrate and low percentage of fine sediments (Sexauer and James 1997; Shepard *et al.* 1984; Pratt 1992).

The size and age of maturity for bull trout is variable, depending upon life-history strategy. Growth of resident fish is generally slower than migratory fish and resident fish tend to be smaller at maturity and less fecund (Fraley and Shepard 1989; Goetz 1989) than the migratory forms. Juvenile bull trout average 50-70 mm (2-3 in) in length at age 1, 100-120 mm (4-5 in) at age 2, and 150-170 mm (6-7 in) at age 3 (Pratt 1992). Individuals normally reach sexual maturity in 4 to 7 years and may live as long as 15-20 years. Repeat and alternate year spawning has been reported, although repeat spawning frequency and post spawning mortality are not well known (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

Preferred spawning habitat consists of low gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989) and water temperatures of 5° to 9° C (41° to 48° F) in late summer to early fall (Goetz 1989). Bull trout typically spawn from August to November. However, adult bull trout in the larger river systems may begin migrating to their spawning areas as early as April, and have been known to move upstream as far as 250 kilometers (km) (155 miles) to spawning grounds (Fraley and Shepard 1989). Typically, spawning occurs in gravel, in runs or tails of spring-fed pools. Adults hold in deep pools or under cover and often migrate at night (Pratt 1992).

Bull trout eggs require very cold incubation temperatures for normal embryonic development (McPhail and Murray 1979). In natural conditions, hatching usually takes 100 to 145 days and newly-hatched fry, known as alevins, require 65 to 90 days to absorb their yolk sacs (Pratt 1992). Consequently, fry do not emerge from the gravel and begin feeding for 200 or more days after eggs are deposited (Fraley and Shepard 1989), usually in about April or May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992). The spawning areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period and channel instability may decrease survival of eggs and young juveniles in the gravel (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993).

Fraley and Shepard (1989) reported that juvenile bull trout were rarely observed in streams with summer maximum temperatures exceeding 15°C (59°F). Fry, and perhaps juveniles, grow faster in cool water (Pratt 1992). Juvenile bull trout are closely associated with the substrate, frequently living on or within detritus or the streambed cobble (Pratt 1992). Along the stream bottom, juvenile bull trout use small pockets of slow water near high velocity, food-bearing water. Juvenile bull trout in four streams in central Washington occupied slow-moving water less than 0.5 m/sec (1.6 ft/sec) over a variety of small to boulder size substrates (Sexauer and James 1997). Adult bull trout, like the young, are strongly associated with the bottom, preferring deep pools in cold water rivers, as well as lakes and reservoirs (Thomas 1992).

Juvenile adfluvial fish typically spend one to three years in natal streams before migrating in spring, summer, or fall to a large lake. After traveling downstream to a larger system from their natal streams, subadult bull trout (age 3 to 6) grow rapidly but do not reach sexual maturity for several years. Growth of resident fish is much slower, with smaller adult sizes and older age at maturity. Growth varies depending upon life-history strategy. Resident adults range from 150 to 300 millimeters (mm) (6 to 12 in.) total length and migratory adults commonly reach 600 mm (24 in.) or more (Pratt 1985; Goetz 1989).

Bull trout are opportunistic feeders with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish and small fish (Wyman 1975; Rieman and Lukens 1979; Rieman and McIntyre 1993; Boag 1987; Goetz 1989; Donald and Alger 1993). Subadult bull trout rapidly convert to eating fish and, as the evolution of the head and skull suggest, adults are opportunistic and largely nondiscriminating fish predators. Historically, native sculpins (*Cottus* spp.), suckers (*Catostomus* spp.), salmonids, and mountain whitefish (*Prosopium williamsoni*) were probably the dominant prey across most of the bull trout range (Fraley and Shepard 1989; Donald and Alger 1993). Today, with many of the bull trout populations confined above reservoirs, introduced species such as kokanee (*Oncorhynchus nerka*) and yellow perch (*Perca flavescens*), are often key food items (Pratt 1992). Primary prey species for anadromous bull trout while in the marine environment include juvenile salmonids as well as Pacific sand lance (*Ammodytes hexapterus*), Pacific herring (*Clupea harengus pallasi*), and surf smelt (*Hypomesus pretious*) (Kraemer in prep.).

Status of Terrestrial Species within the Action Area

Bald Eagle (*Haleaeetus leuecephalus*)

In 1978, the bald eagle was federally listed throughout the lower 48 States as endangered except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as threatened (USDI 1978). In July, 1995, the USFWS reclassified the bald eagle to threatened throughout the lower 48 states. Bald eagle populations have increased in number and expanded their range. The improvement is a direct result of recovery efforts including habitat protection and the banning of DDT and other persistent organochlorines. The 1998 information provided by the Washington Department of Fish and Wildlife (WDFW unpub. data) indicates that 638 nests were known to be occupied and 1.08 young/nest were produced. This is well above the recovery goal of 276 pairs for Washington and meets the recovery criteria of an average of 1.00 young/nest. Since bald eagle populations have met or exceeded recovery goals over most of their range, the species has been proposed for delisting.

Habitat loss continues to be a long-term threat to the bald eagle in the Pacific Recovery Area (Washington, Idaho, Nevada, California, Oregon, Montana, and Wyoming). Urban and recreational development, environmental contaminants, logging, mineral extraction and exploration, and other forms of human activities, will continue to adversely affect the suitability of breeding, wintering, and foraging areas for bald eagles.

The bald eagle is found throughout North America. The largest breeding populations in the contiguous United States occur in the Pacific Northwest states, the Great Lake states, Chesapeake Bay and Florida. The bald eagle winters over most of the breeding range, but is most concentrated from southern Alaska and southern Canada southward.

Most nesting territories in Washington are located on the San Juan Islands, the Olympic Peninsula coastline, and along the Strait of Juan De Fuca, Puget Sound, Hood Canal, and the Columbia River. In addition, bald eagle nesting territories are found within southwestern Washington, the Cascade Mountains, and in the eastern part of the State where adequate sources of prey are available. Most bald eagles winter on river systems in the Puget Trough and the Olympic Peninsula, along the outer coast and Strait of Juan De Fuca, or in the Columbia River Basin.

In Washington, bald eagles are most common along the coasts, major rivers, lakes and reservoirs (USFWS 1986). Bald eagles require accessible prey and trees for suitable nesting and roosting habitat (Stalmaster 1987). Food availability, such as aggregations of waterfowl or salmon runs, is a primary factor attracting bald eagles to wintering areas and influences the distribution of nests and territories (Stalmaster 1987; Keister et al. 1987).

Bald eagle nests in the Pacific Recovery Area are usually located in uneven-aged stands of coniferous trees with old-growth forest components that are located within 1 mile of large bodies of water. Factors such as relative tree height, diameter, species, form, position on the surrounding topography, distance from the water, and distance from disturbance appear to influence nest site selection. Nests are most commonly constructed in Douglas-fir or Sitka spruce trees, with average heights of 116 feet and size of 50 inches dbh (Anthony et al. 1982 in Stalmaster 1987). Bald eagles usually nest in the same territories each year and often use the same nest repeatedly. The territories are generally centered around the primary nest tree and surrounding perch trees and often contain two or more alternate nest sites. Nest sites are generally within 1 mile of water (USFWS 1986). The average territory radius ranges from 1.55

miles in western Washington to 4.41 miles along the lower Columbia River (Grubb 1980; Garrett et al. 1988). In Washington, courtship and nest building activities normally begin in January, with eaglets hatching in mid-April or early May. Eaglets usually fledge in mid-July (Anderson et al. 1986).

During the winter months bald eagles are known to band together in large aggregations where food is most easily acquired. Oregon and Washington support approximately 25 percent of the wintering bald eagles in the conterminous United States. Wintering sites are typically in the vicinity of concentrated food sources such as anadromous fish runs, high concentrations of waterfowl or mammalian carrion. A number of habitat features are desirable for wintering bald eagles. Key contributing factors are available fish spawning habitat with exposed gravel bars in areas close to bald eagle perching habitat. Bald eagles select perches that provide a good view of the surrounding territory, typically the tallest perch tree available within close proximity to a feeding area (Stalmaster 1987). Tree species commonly used as perches are black cottonwood, big leaf maple, or Sitka spruce (Stalmaster and Newman 1979).

Wintering bald eagles may roost communally in single trees or large forest stands of uneven ages that have some old-growth forest characteristics (Anthony et al. 1982 in Stalmaster 1987). Some bald eagles may remain at their daytime perches through the night but bald eagles often gather at large communal roosts during the evening. Communal night roosting sites are traditionally used year after year and are characterized by more favorable micro climatic conditions. Roost trees are usually the most dominant trees of the site and provide unobstructed views of the surrounding landscape (Anthony et al. 1982 in Stalmaster 1987). They are often in ravines or draws that offer shelter from inclement weather (Hansen et al. 1980; Keister 1987). A communal night roost can consist of two birds together in one tree, or more than 500 in a large stand of trees. Roosts can be located near a river, lake, or seashore and are normally within a few miles of day-use areas but can be located as far away from water as 17 miles or more. Prey sources may be available in the general vicinity, but close proximity to food is not as critical as the need for shelter that a roost affords (Stalmaster 1987).

Bald eagles utilize a wide variety of prey items, although they primarily feed on fish, birds and mammals. Diet can vary seasonally, depending on prey availability. Given a choice of food, however, they typically select fish. Many species of fish are eaten, but they tend to be species that are easily captured or available as carrion. In the Pacific Northwest, salmon form an important food supply, particularly in the winter and fall. Birds taken for food are associated with aquatic habitats. Ducks, gulls and seabirds are typically of greatest importance in coastal environments. Mammals are less preferred than birds and fish, but form an important part of the diet in some areas. Deer and elk carcasses are scavenged, and in coastal areas, eagles feed on whale, seal, sea lion and porpoise carcasses (Stalmaster 1987).

Columbian White-tailed Deer (*Odocoileus virginianus leucurus*)

Two populations of this subspecies exist, one in Douglas County, Oregon, (Douglas County population), and the other in Columbia and Clatsop Counties, Oregon, and Wahkiakum County, Washington (Columbia River population). The Columbia River population was listed as endangered in 1967 under the Endangered Species Preservation Act, and the Douglas County population received protection under the Act as a threatened species in 1977. The Columbian River population has increased from fewer than 400 animals in 1977 to 550 to 800 individuals in 1994-1997 (USFWS 1997, unpublished data).

This deer is medium-sized, with a coat that is tawny in the summer and bluish-gray in winter. Bucks weigh up to 182 kg (400 lb), whereas does are smaller, usually weighing less than 113 kg (250 lb). Female Columbian white-tailed deer typically have one or two fawns every season. Young deer have a reddish-tan coat with small white speckles. The greatest human-caused threat to the Columbian white-tailed deer is the degradation of riparian habitats. Other human-caused threats include automobile collisions, poaching, entanglement in barbed wire fences, and competition with livestock. Natural threats include flooding, disease, and parasites (USFWS 1983a).

The Columbian white-tailed deer is one of 38 subspecies of white-tailed deer in the Americas. Historically, the subspecies ranged from the southern end of Puget Sound in Washington to the Willamette Valley of Oregon and throughout the river valleys west of the Cascade Mountains (Bailey 1936). Following European settlement, conversion of land to agriculture pushed the deer into small vestiges of habitat. They are now confined to a small area near the mouth of the Columbia River and in the upper Umpqua River drainage near Roseburg, Oregon. In Washington, Columbia white-tailed deer are only found in Wahkiakum County on islands in, and along the banks of, the Columbia River. Most of the habitat occupied by the deer on the Washington mainland is within the boundaries of the Julia Butler Hansen Refuge for the Columbian white-tailed Deer.

Columbian white-tailed deer are found on islands containing mature forest land, and on bottomland farms, forested swamps, and riparian areas adjacent to the Columbia River. Distribution of deer throughout this area is strongly related to the availability of woody vegetation for cover (Suring and Vohs 1979). Suring and Vohs (1979) reported little use of those portions of pastures located more than 250 m (750 feet) from woodland edges. The deer prefer plant communities that provide both forage and cover; park forest is preferred. Other important plant communities include open canopy forests, sparse rush, and dense thistle (USFWS 1983a). Peak fawning occurs the second week of June.

Their feeding preferences shifts seasonally. Studies at the Julia Butler Hansen Refuge for the Columbian White-tailed Deer show herbs to be preferred foraging items spring through fall. The use of browse is most important in winter and fall (Dublin 1980).

Sidalcea nelsoniana (Nelson's checkermallow)

Nelson’s checkermallow bears tall lavender to deep pink flowers borne in clusters 50-150 cm (1.6-5 ft) tall at the end of short stalks. Inflorescences are usually somewhat spike-like, elongate and somewhat open (Hitchcock 1969). Plants have either perfect flowers (male and female) or pistillate flowers (female). The plant can reproduce vegetatively, by rhizomes, and by producing seeds, which drop near the parent plant. Flowering can occur as early as mid-May and extend into September in the Willamette Valley. Fruits have been observed as early as mid-June and as late as mid-October. Coast Range populations generally flower later and produce seed earlier, probably because of the shorter growing season (CH_2M Hill 1991).

Sidalcea nelsoniana was listed as a threatened species, without critical habitat, in February 1993 (USDI 1993c). The species is a perennial herb in the mallow family (Malvaceae). The majority of sites for the species occur in the Willamette Valley of Oregon; the plant is also found at several sites in the Coast Range of Oregon and at two sites in the Puget Trough of southwestern Washington. Thus the range of the plant extends from southern Benton County, Oregon, north to Cowlitz County, Washington, and from central Linn County, Oregon, west to just west of the crest of the Coast Range. In the Willamette Valley, Nelson’s checkermallow occurs on soils in the Wapto, Bashaw and Mcalpin Series (NRCS mapped soil unit STATSGO 81); in Oregon’s Coast Range, the plant is found on soils in the Malabon, Coburg and Salem Series (NRCS mapped soil unit STATSGO 91) (Dr. Andrew F. Robinson, Ph.D., USFWS, Oregon State Office, Portland, Oregon, personal communication, 1999).

Threats to the populations include: mowing, plowing, stream channel alteration, recreational activities, roadside spraying, conversion of habitat to agricultural uses, logging, water impoundment and loss of suitable habitat (USDI 1993c). Stream channel alterations, such as straightening, splash dam installation, and rip-rapping cause accelerated drainage and reduce the amount of water that is diverted naturally into adjacent meadow areas. As a result, areas that would support Nelson’s checkermallow are lost. The species is now known to occur in 62 patches within five relict population centers in Oregon, and at two sites in Washington (CH_2M Hill 1991).

The range of *Sidalcea nelsoniana* extends from southern Benton County, Oregon north to Cowlitz County Washington, and from central Linn County Oregon west, to just west of the crest of the Coast Range of Oregon (USDI 1993c). *Sidalcea nelsoniana* is known to be present in restricted areas of the Willamette Valley and the adjacent Coast Range of Oregon and at one site in the Willapa Hills/Coast Range extension into Cowlitz County, Washington (USDI 1993c). Historically, there were at least six identified population centers in Oregon (this does not include the recently discovered population center in Washington State), (USDI 1998). One population center has been extirpated in the Willamette Valley, four population centers remain in the Willamette Valley, one population center exists in the Coast Range, and one population center in the Willapa Hills/Coast Range extension in southwest Washington (USDI 1993c). Within this range, a total of 48 sites within six population centers are present (USDI 1998).

Nelson's checkermallow most frequently occurs in ash (*Fraxinus* sp.) swales and meadows with wet depressions, or along streams. The species also grows in wetlands within remnant prairie grasslands. Some sites occur along roadsides at stream crossings where exotics such as blackberry (*Rubus* spp.) and Queen Anne's lace (*Daucus carota)* are also present (USDI 1993c). Nelson's checkermallow primarily occurs in open areas with little or no shade and will not tolerate encroachment of woody species. In the Willamette Valley of Oregon, the species generally occurs in prairie situations interspersed with oak and ash woodlands and coniferous forests (USDI 1993c). These prairies were historically maintained by fire. Fire suppression, conversion to agricultural land use, and invasion by introduced grasses and forbs are primary threats to this species. In the Oregon Coast Range and the Willapa Hills of Washington, *Sidalcea nelsoniana* occurs along streams in meadows and other relatively open sites. These areas in the Coast Range of Oregon and the Willapa Hills of Washington have been impacted by logging practices which may result in destruction of the plant, changes to groundwater hydrology, and introduction of woody species which compete with *Sidalcea nelsoniana* (USDI 1993c). Soil types that the plant occurs on have been documented as moist to dry sites with poorly to well drained clay, clay loam and gravelly loam soils in meadow and rarely wooded habitats (CH2MHill 1986; Glad et al. 1987). Plant associations include yarrow (*Achillea*), various grasses (*Festuca, Agrostis, Elymus*) and sedges (*Carex*) (USDI 1993c).

Bradshaw's Lomatium *(Lomatium bradshawii)*

Bradshaw's lomatium was listed as federally endangered in September 1988 (USFWS 1993b). The population sizes have been estimated to be approximately 2,500 and over 70,000 individuals at the two Washington sites (Wentworth 1996). The species is threatened by the destruction or modification of habitat through agricultural, residential and commercial development. Fire suppression permits the invasion of grassland vegetation by woody and invasive species, thus rendering habitat unsuitable, and precludes the expansion of *Lomatium bradshawii* populations. Activities that affect the hydrology of the area may have an impact on the populations. Although the effects of cattle grazing, rodent seed predation, and fungal and insect infestations have not been studied in Washington, they have been documented as negatively impacting *Lomatium bradshawii* in Oregon. Rodent activity is evident at the two Washington sites (Wentworth 1996).

Most of the Bradshaw's lomatium populations are known from habitat fragments in the Willamette Valley of western Oregon (Wentworth 1996). The species occurs in four counties in Oregon and one county in Washington. In 1994, two populations were discovered in Clark County, Washington. Prior to the 1994 discovery, *Lomatium bradshawii* was not known to occur in Washington (Gaddis 1996 in Wentworth 1996).

Bradshaw's lomatium is a member of the parsley family (Apiaceae), and grows from 20-50 cm (8-20 in) in height, with mature plants having only two to six leaves. Leaves are chiefly basal and are divided into very fine, almost threadlike, linear segments. The yellow flowers are small, measuring about 1 mm (0.05 in) long and 0.5 mm (0.025 in) across, and are grouped into asymmetrical umbels. Each umbel is composed of 5 to 14 umbellets, which are subtended by green bracts divided into sets of three. This bract arrangement differentiates *L. bradshawii* from other lomatiums. Bradshaw's lomatium blooms during April and early May, with fruits appearing in late May and June. Fruits are oblong, about 1.2 cm (0.5 in) long, corky and thick-winged along the margin, and have thread-like ribs on the dorsal surface. This plant reproduces entirely from seed. Insects observed to pollinate this plant include a number of beetles, ants, and some small native bees.

Lomatium bradshawii occurs in remnant fragments of once widespread low elevation grasslands and prairies. The habitat type is described as wet, seasonally flooded prairies and grasslands common around creeks and small rivers (Moir and Mika 1976; Alverson 1989). The Washington populations of *Lomatium bradshawii* occur in wet meadows, one dominated by *Deschampsia cespitosa* and the other dominated by non-native grasses. The community ranges from wetter, with sedges and rushes as associated species, to drier, with more native and non-native grasses (Wentworth 1996). Bradshaw's lomatium is found in areas with alluvial soils. Soils at these sites are dense, heavy clays, with a slowly permeable clay layer located 15-30 cm (6-12 in) below the surface. This clay layer results in a perched water table during winter and spring, and so is critical to the wetland character of these grasslands, known as tufted hair-grass (*Deschampsia cespitosa*) prairies. The species occurs on soils in the Wapto, Bashaw and Mcalpin Series (NRCS mapped soil unit STATSGO 81)(Dr. A.F. Robinson, Ph.D., personal communication, 1999).

<u>Ute Ladies'tresses *(Spiranthes diluvialis)*</u>

Ute Ladies' tresses, a member of the orchid family, was federally listed as threatened in 1992. The main threat factors cited were loss and modification of habitat, and modification of the hydrology of existing and potential habitat. The orchids pattern of distribution as small, scattered groups, its restricted habitat, and low reproductive rate under natural conditions make it vulnerable to both natural and human caused disturbances (USFWS 1995). These life history and demographic features make the species more vulnerable to the combined impacts of localized extirpations, diminishing potential habitat, increasing distance between populations, and decreasing population sizes (Belovsky et al. 1994; USFWS 1995).

In the State of Washington, *Spiranthes diluvialis* is only known to occur in Okanogan County.

Ute ladies'tresses is a perennial, terrestrial orchid that is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams (USFWS 1995). Observations by Jennings (1990) and Coyner (1989 and 1990) indicate that the Ute ladies'tresses requires soil moisture to be at or near the surface throughout the growing season, indicating a close affinity with the flood plain. These observations were corroborated by Martin and Wagner (1992) with monitoring research at the Dinosaur National Monument. However, Riedel (1992) reported that once established it appears to be tolerant of somewhat drier conditions, but loses vigor and may gradually die out if the groundwater table begins to consistently drop during late summer (Riedel 1992; Arft 1994 pers. comm. *in* USFWS 1995).

Ute ladies' tresses were originally reported to occur at elevations between 4,300 and 7,000 feet in eastern Utah and Colorado (Stone 1993). However, recent discoveries of small populations in the Snake River Basin (1996; southeastern Idaho) and in Okanogan County, Washington (1997) indicates that orchids are found at lower elevations (1,500-4,000 feet) in the more western part of their range (USFWS 1995). Ute ladies'tresses are found in a variety of soil types ranging from fine slit/sand to gravels and cobbles (USFWS 1995). They have also been found in areas that are highly organic or consist of peaty soils. Ute ladies'tresses are not found in heavy or tight clay soils or in extremely saline or alkaline soils (pH>8.0) (USFWS 1995).

Ute ladies' tresses occur primarily in areas where vegetation is relatively open and not overly dense or overgrown (Coyner 1989 and 1990; Jennings 1989 and 1990) . A few populations have been found in riparian woodlands of eastern Utah and Colorado (USFWS 1995). However, the orchid is generally intolerant of shade, preferring open, grass and forb-dominated sites (USFWS 1995).

The associated plant community composition and structure is frequently a good indicator across the range of the orchid (USFWS 1995). For example, beaked spikerush (*Eleocharis rostellata*) appears to dominate the plant community in areas occupied by the orchid (Washington State). In Idaho, Ute ladies' tresses occupies areas dominated by silverleaf (*Elaeagnus commutata*) and creeping bentgrass (*Agrostis stolonifera*). The USFWS (1995) reported that species most commonly associated with Ute ladies'tresses throughout its range include creeping bentgrass, baltic rush (*Juncus balticus*), long-styled rush (*J. longistylis*), scouring rush (*Equisetum laevigatum*), and bog orchid (*Habenaria hyperborea*). Coyote willow (*Salix exigua*) and yellow willow (*S. lutea*) are commonly present in small numbers as saplings and small shrubs (USFWS 1995). Other species commonly associated with the Ute ladies'tresses throughout its range include paint-brush (*Castilleja* spp.), thinleaf alder saplings (*Alnus incana*), narrowleaf cottonwood saplings (*Populus angustifolia*), sweet clover (*Melilotus* spp.), sedges (*Carex* spp.), red clover (*Trifolium pratense*), and western goldenrod (*Solidago occidentalis*).

The Ute ladies'tresses appears to be tolerant and well adapted to disturbances, especially those caused by water movement through flood plains over time (Naumann 1992 and Riedel 1994 pers. comm. *in* USFWS 1995). Habitat alteration resulting from agricultural use (grazing, mowing, and burning) may be beneficial, neutral, or detrimental (McClaren and Sundt 1992). Grazing and mowing seem to promote flowering, presumably by opening the canopy to admit more light. However, these management practices may impede fruit set by directly removing flowering stalks, enhancing conditions for herbivory by small mammals and altering habitat required by bumble bees, the primary pollinator (USFWS 1995; Arft 1993)

Ute Ladies' tresses flower from mid-July to mid-August. Fruits mature and dehisce from mid-August into September. Plants may remain dormant for one or more growing seasons without producing above ground shoots. Orchids generally require symbiotic associations with mycorrhizal fungi for seed germination.

Factors Affecting Species Environments Within the Action Area

Populations of anadromous salmonids are at risk or already extinct in many river basins of Washington, leading to many listings and proposed listings for anadromous fish. Disease, predation, competition from introduced species, climatic variation and unfavorable ocean conditions are among the many natural events that have taken a toll (Botkin *et al.* 1995; NMFS 1995; Spence *et al.* 1996; State of Washington 1993). These natural events exacerbated population and habitat declines induced by human activities such as land and water development, over harvest, artificial propagation, and water pollution (Botkin *et al.* 1995; NMFS 1995; Spence *et al.* 1996; State of Washington1993).

Many land and water management activities have degraded habitats of declining salmonids. Significant examples include water withdrawals, unscreened water diversions, crop production, livestock production, hydropower development, road construction, removal of large woody debris from streams, splash dams, timber harvest, mining, urbanization and outdoor recreation (Botkin *et al.* 1995; NMFS 1995; Spence *et al.* 1996; State of Washington 1993). Connectivity (defined as the flow of energy, organisms, and materials between streams, riparian areas, floodplains, and uplands) has been reduced. Delivery of fine sediment to streams has increased, filling pools and reducing spawning and rearing habitats for fish. The volume and distribution of instream and riparian large woody debris that traps sediment, stabilizes stream banks, and helps form pools, has been reduced. Vegetative canopies that reduce temperature fluctuations have been reduced or eliminated. Streams have become straighter, wider, and shallower, thus reducing spawning and rearing habitats and increasing temperature fluctuations. Hydrological regimes have been altered, including the timing, size and other characteristics of peak flow regimes necessary to sustain channel conditions and sustain fish migration behavior. Floodplain function, water tables and base flows have been altered resulting in riparian, wetland and stream dewatering. Finally, increases in heat, nutrients and toxicants have degraded water quality.

The Services conclude that not all of the biological requirements of the species within the action area are being met under current conditions, based on the best available information on the status of the listed, proposed and candidate species rangewide and within the action area; information regarding population status, trends, and genetics; and the environmental baseline conditions within the action area. Significant improvement in habitat conditions is needed to meet the biological requirements for survival and recovery of these species. Any further degradation of these conditions would have a significant impact on the future of the affected species.
CREP will be implemented on agricultural lands in Washington. This section contains an analysis of past and ongoing agricultural practices on stream environments, based largely on Spence *et al.* 1996. The purpose of this extended discussion is to provide a substantial context for nondiscretionary measures included in the incidental take statement issued with this

Biological Opinion, and for discretionary conservation recommendations that FSA should carry out to fulfill its section 7 (a)(1) obligations.

1. Grazing Lands

Livestock grazing is the second most dominant nonfederal land use in Washington, following timber production. Grazing currently occurs on about 1 million acres of federal lands, about 1 million acres of state lands and about 8.5 million acres of private rangeland (Palmisano et al 1993). In 1999 more than 856,000 cattle were slaughtered in Washington State (USDA 1999). The vast majority of rangeland (about 98%) occurs on the east side of the Cascade Range.

Range condition is a measure of rangeland health. Heavy livestock grazing in the western United States beginning in the mid-to-late 19th century and continuing in many areas until the mid 20th century or later severely damaged many rangelands. The 1982 National Resource Inventory documented widespread degradation of Washington's rangelands and found that 34 percent of Washington's rangelands were in "poor" condition, 32 percent were "fair" and only 21 percent were classified as "good" (USDA 1989). Despite improved upland conditions in many areas, extensive field observations in the late 1980's suggest riparian areas in much of the West are in the worst condition in history (Chaney *et al*. 1993). In April 1997, USDA officially launched a National Riparian Buffer Initiative, with a goal of establishing two million miles of conservation buffers by the year 2002 to help restore streams damaged by grazing and crop production (USDA 1997).

Despite the generally poor condition of most riparian areas, the potential for restoring riparian areas damaged by grazing is arguably greater than for those affected by other activities (Behnke 1977; Platts 1991). Recovery of grasses, willows and other woody species can occur within a few years when grazing pressure is reduced or eliminated (Elmore and Beschta 1987; Platts 1991; Elmore 1992). Restoration of fully functioning riparian areas that support a variety of plant species, including older forests of cottonwood and other large tree species, will take considerable time. Nevertheless, many important riparian functions such as shading, bank stabilization, sediment and nutrient filtering, and allochthonous inputs may be rapidly restored to the benefit of salmonids, provided the stress of grazing is alleviated and prior damage has not been too severe.

1. Grazing Effects on Vegetation

Heavy livestock grazing around the turn of the century had significant and widespread effects, many of which persist today, on upland and riparian vegetation. Rangelands have experienced decreases in the percentage of ground covered by vegetation and associated organic litter (Heady and Child 1994). Species composition of plants in upland areas has shifted from perennial grasses toward nonnative annual grasses and weedy species (Heady and Child 1994). In riparian areas, willow, aspen, sedge, rush, and grass communities have been reduced or eliminated and replaced with annual grasses or sagebrush. Diaries of early trappers in eastern Oregon noted that grasses were as high as seven feet (Wilkinson 1992) and that streams were well lined with willows, aspen, and other woody vegetation (Elmore 1992). In eastern Oregon meadows, alteration of the vegetation has been so pervasive that little is known about the native vegetation that once inhabited riparian meadow communities. Currently, these meadows are dominated by Kentucky bluegrass, big sagebrush, and annual brome grasslands (Johnson *et al*. 1994). Kauffman and Pyke (in press), Belsky *et al.* (1999) and Fleischner (1994) recently reviewed the literature and found many examples of deleterious changes in species composition, diversity, and richness associated with livestock grazing and beneficial changes associated with removal of livestock in western states.

Much early alteration of rangelands was by settlers who engaged in widespread clearing of grasslands and riparian forests to grow crops, build houses, obtain fuelwood, and increase availability of land for domestic animals (Heady and Child 1994). Conversion of lands for livestock production continues today. Woody shrubs and trees are sometimes removed by using anchor chains or cables stretched between tractors to uproot vegetation and increase grass production (Heady and Child 1994). Removal of woody shrubs through chemical application or by mechanical means is also a common practice in range management. In addition, suppression of fire on rangelands is responsible for changes in upland vegetation, including encroachment by juniper in many areas of eastern Oregon and Washington (Miller *et al*. 1989).

Cattle and sheep affect vegetation primarily through browsing and trampling. Grazing animals are selective in what they eat; consequently, preferred vegetation types are generally removed first, followed by less palatable species. Heavy, continual grazing causes plants to be partially or wholly defoliated, which can reduce biomass, plant vigor, and seed production (Kauffman 1988; Heady and Child 1994). Selection of specific plant species may allow other taxa to dominate (Kauffman and Krueger 1984; Fleischner 1994). Vegetation may also be lost or damaged through trampling, which tears or bruises leaves and stems, and may break stems of woody plants. Regeneration of some woody vegetation, such as willow, cottonwood, and aspen, is inhibited by browsing on seedlings (Fleischner 1994). Vegetation may also be directly lost when buried by cattle dung. In a dairy pasture, MacDiarmid and Watkin (1971) found that 75 percent of grasses and legumes under manure piles were killed.

Livestock grazing also influences vegetation by modifying soil characteristics. Hooves compact soils that are damp or porous, which inhibits the germination of seeds and reduces root growth (Heady and Child 1994). Changes in infiltration capacity associated with trampling may lead to more rapid surface runoff, lowering moisture content of soil and the ability of plants to germinate or persist (Heady and Child 1994). However, sometimes, trampling may break up impervious surface soils, allowing for greater infiltration of water and helping to cover seeds (Savory 1988 in Heady and Child 1994). Soils in arid and semi-arid lands have a unique microbiotic surface layer or crust of symbiotic mosses, algae, and lichens that covers soils between and among plants. This "cryptogamic crust" plays an important role in hydrology and nutrient cycling and is believed to provide favorable conditions for the germination of vascular plants (Fleischner 1994). Trampling by livestock breaks up these fragile crusts, and reformation may take decades. Anderson *et al*.

(1982) found recovery of cryptogamic crusts took up to 18 years in ungrazed exclosures in Utah. Finally, livestock indirectly affect plant species composition by aiding the dispersion and establishment of nonnative species; seeds may be carried on the fur or in the dung of livestock (Fleischner 1994).

The effects of livestock grazing on vegetation are especially intense in the riparian zone because of the tendency for livestock to congregate in these areas. Gillen *et al*. (1984) found that 24 percent to 47 percent of cattle in two pastures in north-central Oregon were observed in riparian meadows occupying only 3 percent to 5 percent of the total land area. Roath and Krueger (1982) reported that riparian meadows that are only 1 percent to 2 percent of the total land area accounted for 81 percent of the total herbaceous biomass removed by livestock. Similar preferences for riparian areas have been observed elsewhere in the west (reviewed in Kauffman and Krueger 1984; Fleischner 1994). Cattle and sheep typically select riparian areas because they offer water, shade, cooler temperatures, and an abundance of high quality food that typically remains green longer than in upland areas (Kauffman and Krueger 1984; Fleischner 1994; Heady and Child 1994). In mountainous terrain, the preference of cattle and sheep for the riparian zone also appears related to hillslope gradient (Gillen *et al*. 1984). Heady and Child (1994) suggest that cattle avoid slopes greater than 10 to 20 percent. The intensity of use by livestock in riparian zones exacerbates all of the problems noted above and generates additional concerns. Alteration of flow regimes, changes in the routing of water, and incision of stream channels can lead to reduced soil moisture in the floodplain. Many types of riparian vegetation are either obligate or facultative wetland species adapted to the anaerobic conditions of permanently or seasonally saturated soils. Stream downcutting and the concomitant lowering of the water table can lead to encroachment of upland species, such as sagebrush and bunchgrasses into areas formerly dominated by willows, sedges, rushes and grasses (Elmore 1992). In addition, flood events may be important mechanisms for seed dispersal throughout the floodplain for woody plants, a function diminished as channels are incised.

2. Effects on Soils

Rangeland soils are frequently compacted by livestock. The degree of soil compaction depends on soil characteristics, including texture, structure, porosity, and moisture content (Platts 1991; Heady and Child 1994). Generally, soils that are high in organic matter, porous, and composed of a wide range of particle sizes are more easily compacted than other soils. Similarly, moist soils are usually more susceptible to compaction than dry soils, although extremely wet soils may give way and then recover following trampling by livestock (Clayton and Kennedy 1985). The result of soil compaction is an increase in bulk density (specific gravity) in the top five to 15 cm of soil as pore space is reduced. Because of the loss of pore space, infiltration is reduced and surface runoff is increased, thereby increasing the potential for erosion. The available studies show that compaction generally increases with grazing intensity, but that site-specific soil and vegetative conditions are important in determining the response of soils to grazing activity (reviewed in Kauffman and Krueger 1984; Heady and Child 1994).

Trampling by livestock may also displace or break up surface soils. In instances where surface soils have become impervious to water, light trampling may increase the soil's ability to absorb water. On the other hand, loosening soils makes them more susceptible to erosion. Heavily pulverized soil (dust) may become hydrophobic, reducing infiltration and increasing surface runoff. In arid and semi-arid climates, the cryptogamic crust has been shown to increase soil stability and water infiltration (Loope and Gifford 1972; Kleiner and Harper 1977; Rychert *et al*. 1978). Disruption of the cryptogamic crust may thus have long-lasting effects on erosional processes.

Livestock also alter surface soils indirectly by removing ground cover and mulch, which in turn affects the response of soils to rainfall. Kinetic energy from falling raindrops erodes soil particles (splash erosion), which may then settle in the soil interstices resulting in a less pervious surface. Livestock grazing can increase the percentage of exposed soil and break down organic litter, reducing its effectiveness in dissipating the energy of falling rain.

3. Effects on Hydrology

Grazing modifies two fundamental hydrologic processes, evapotranspiration and infiltration, that ultimately affect the total water yield from a watershed and the timing of runoff to streams. Loss of upland and riparian vegetation results in reduced interception and transpiration losses, thus increasing the percentage of water available for surface runoff (Heady and Child 1994). Shifts in species composition from perennials to annuals may also reduce seasonal transpiration losses. Reductions in plant biomass and organic litter can increase the percentage of bare ground and can enhance splash erosion, which clogs soil pores and decreases infiltration. Similarly, soil compaction reduces infiltration. Rauzi and Hanson (1966) report higher infiltration rates on lightly grazed plots, compared with moderately and heavily grazed plots in South Dakota. Similar experiments in northeastern Colorado showed reductions in infiltration in heavily grazed plots, but no differences between moderately and lightly grazed plots (Rauzi and Smith 1973). Johnson (1992) reviewed studies related to grazing and hydrologic processes and concluded that heavy grazing nearly always decreases infiltration, reduces vegetative biomass, and increases bare soil.

Decreased evapotranspiration and infiltration increases and hastens surface runoff, resulting in a more rapid hydrologic response of streams to rainfall. Some authors have suggested that the frequency of damaging floods has increased in response to grazing; however, there remains uncertainty about the role of grazing in mediating extreme flow events (reviewed in Belsky *et al.* 1999 and Fleischner 1994).

Reduced stability of streambanks associated with loss of riparian vegetation can lead to channel incision or "downcutting" during periods of high runoff. In naturally functioning systems, riparian vegetation stabilizes streambanks, slows the flow of water during high flow events, and allows waters to spread out over the floodplain and recharge subsurface aquifers (Elmore 1992). Moreover, riparian vegetation facilitates sediment deposition and bank building, increasing the capacity of the floodplain to store water, which is then slowly released as baseflow during the drier seasons (Elmore and Beschta 1987). Downcutting effectively separates the stream channel from the floodplain, allowing flood waters to be quickly routed out of the system and leading to lowering of the water table (Platts 1991; Elmore 1992; Armour *et al*. 1994). Consequently, summer streamflows may decrease although total water yield increases in response to vegetation removal (Elmore and Beschta 1987). Li *et al*. (1994) found that streamflow in a heavily grazed eastern Oregon stream became intermittent during the summer, while a nearby, well-vegetated reference stream in a similar-sized watershed had permanent flows. They suggested that the difference in flow regimes was a consequence of diminished interaction between the stream and floodplain with resultant lowering of the water table.

4. Effects on Sediment Transport

The presence of livestock in the riparian zone increases sediment transport rates by increasing both surface erosion and mass wasting (Platts 1991; Marcus *et al*. 1990; Heady and Child 1994). Devegetation and exposure of soil by grazing helps to detach soil particles during rainstorms, thus increasing overland sediment transport. Rills and gullies often form in areas denuded by livestock trails or grazing, resulting in increased channelized erosion (Kauffman *et al*. 1983). As gullies expand and deepen, streams downcut, the water table drops, and sediments are transported to depositional areas downstream (Elmore 1992; Fleischner 1994; Henjum *et al*. 1994). Stream downcutting leads to further desertification of the riparian area and promotes soil denudation and the establishment of xeric flora. This also increases the potential for soil erosion. Some evidence suggests that significant channel downcutting in the Southwest occurred before the introduction of livestock (Karlstrom and Karlstrom 1987 in Fleischner 1994); however, studies in eastern Oregon and northern California implicate livestock as a major cause of downcutting (Dietrich *et al*. 1993; Peacock 1994).

Mass wasting of sediment occurs along stream banks where livestock trample overhanging cut banks (Behnke and Zarn 1976; Platts and Raleigh 1984; Fleischner 1994). Grazing also removes vegetation that stabilizes streambanks (Platts 1991). Where banks are denuded, undercutting and sloughing occurs, increasing sediment loads, filling stream channels, changing pool-riffle ratios, and increasing channel width (Platts 1981 in Fleischner 1994).

5. Effects on Thermal Energy Transfer and Stream Temperature

Riparian vegetation shades streams and regulates stream temperatures. On rangelands east of the Cascades, black cottonwood, mountain alder and quaking aspen are the dominant deciduous tree species in natural communities, whereas west of the Cascades, black cottonwood, red alder and big leaf maple are dominant (Kauffman 1988). Shrubby vegetation, such as willows, may also be an important source of shade along smaller streams and in mountainous areas (Henjum *et al*. 1994), and even tall grasses can provide some measure of shade along narrow first and second-order streams (Platts 1991).

The removal of riparian vegetation along rangeland streams can result in increased solar radiation and thus increased summer temperatures. Li (1994) noted that solar radiation reaching the channel of an unshaded stream in eastern Oregon was six times greater than that reaching an adjacent, well-shaded stream and that summer temperatures were 4.5 ^{o}C warmer in the unshaded tributary. Below the confluence of these two streams, reaches that were unshaded were significantly warmer than shaded reaches both upstream and downstream. A separate comparison of water temperatures at two sites of similar elevation in watersheds of comparable size found temperature differences of 11^{o}C between shaded and unshaded streams (Li 1994). Warming of streams from loss of riparian vegetation is likely widespread in eastern Washingon and may be particularly acute because of low summer flows and many cloud-free days.

The effects of a riparian canopy in winter on stream temperatures are less well understood and various studies have shown increases, decreases, and no change in water temperature following removal of a riparian canopy (reviewed in Beschta *et al*. 1987). Riparian cover can inhibit energy losses from evaporation, convection, and long-wave radiation during the winter. Several authors have suggested that removal of vegetation can increase radiative heat loss and add to the formation of anchor ice (Beschta *et al*. 1991; Platts 1991; Armour *et al*. 1994). This is most likely to occur in regions where skies are clear on winter nights and where snow-cover is inadequate to blanket and insulate streams (Beschta *et al*. 1987), primarily in mountainous regions.

Alteration of stream temperature processes may also result from changes in channel morphology. Streams in areas that are improperly grazed are wider and shallower than in ungrazed systems, exposing a larger surface area to incoming solar radiation (Bottom *et al*. 1985; Platts 1991). Wide, shallow streams heat more rapidly than narrow, deep streams (Brown 1980). Similarly, wide, shallow streams may cool more rapidly, increasing the likelihood of anchor ice formation. Reducing stream depth may expose the stream bottom to direct solar radiation, which may allow greater heating of the substrate and subsequent conductive transfer to the water.

6. Effects on Nutrients and Other Solutes

Livestock activities can directly affect nutrient dynamics through several mechanisms. The removal of riparian vegetation by grazing reduces the supply of nutrients provided by organic leaf litter. Livestock also redistribute materials across the landscape. Because riparian areas are favored by cattle and sheep, nutrients eaten elsewhere on the range are often deposited in riparian zones or near other attractors, such as salt blocks (Heady and Child 1994). The deposition of nutrients in riparian areas increases the likelihood that elements such as nitrogen and phosphorous will enter the stream. Nutrients derived from livestock wastes may be more bioavailable than those bound in organic litter. Elimination of the cryptogamic crust by livestock may also alter nutrient cycling in arid and semi-arid systems. These microbiotic crusts complete most of the nitrogen fixation in desert soils (Rychert *et al*. 1978). Loss of these crusts can reduce the availability of nitrogen for plant growth, potentially affecting plant biomass in uplands (Kauffman and Pyke, in press; Belsky *et al.* 1999, Fleischner 1994).

Riparian areas play a major role in regulating the transportation and transformation of nutrients and other chemicals. As stream channels incise and streams are separated from their floodplains, soil moisture is reduced, which in turn alters the quantity and form of nutrients and their availability to aquatic communities. In the anaerobic environments of saturated soils, microbial activity transforms nitrate nitrogen (NO_3) into gaseous nitrous oxide (N_2O) and elemental nitrogen (N_2) liberated to the atmosphere (Green and Kauffman 1989). Under drier soil conditions (oxidizing environments), denitrification does not occur and nitrate-nitrogen concentrations in the soil increase. Because nitrate is negatively charged, it is readily transported by subsurface flow to the stream channel (Green and Kauffman 1989). Thus, by altering the hydrologic conditions in the riparian zone, grazing can increase how much nitrate nitrogen is released to streams. Excessive nitrate concentrations encourage algal growth, increase turbidity, and may cause oxygen depletion because of increased biochemical oxygen demand.

The form of other elements including manganese, iron, sulfur, and carbon also depends on the redox potential of soils. In their reduced form, manganese, iron, and sulfur can be toxic to plants at high concentrations (Green and Kauffman 1989). Obligate and facultative wetland plant species have special adaptations for coping with these reduced elements that allow them to survive where more xeric plants cannot. Thus, changes in hydrologic condition caused by downcutting can modify the form of elements available to plants, altering competitive interactions between plants and changing riparian plant communities.

7. Effects of Vegetation Management

Fertilizers, herbicides, mechanical treatments, and prescribed fire are commonly used in rangeland management to alter vegetation in favor of desired species. In principle, the potential effects of these activities on salmonids and their habitats are no different from similar activities in forested environments. However, because the physical and biological processes that regulate the delivery of water, sediments, and chemicals to streams differ on forests and rangelands, so may be the response of aquatic ecosystems.

Fertilizers are used on rangelands to increase forage production, improve nutritive quality of forage, and enhance seedling establishment, although the high costs and varied results have led to a decline in fertilizing rangeland in the past 20 years (Heady and Child 1994). Fertilizers that reach streams through direct application or runoff can adversely affect water quality. Nutrient enrichment (especially nitrogen) promotes algal growth, which in turn can lead to oxygen depletion as algae die and decompose. Conversely, fertilizer applied to rangelands may reduce sedimentation, hydrologic, and temperature effects by stimulating recovery of vegetation, including woody riparian shrubs.

Herbicides are typically used to target unpalatable or noxious weeds that compete with desired forage species. Many herbicides commonly used in forestry (e.g., 2,4-D, picloram, glyphosate, tricopyr) are used in range management as well, although other highly selective herbicides may be used to control particular weeds common to rangelands, including unpalatable woody shrubs. Direct toxic effects on aquatic biota may occur where herbicides are applied directly to stream channels; however, risks of contamination can be reduced if adequate no-spray buffers are maintained (Heady and Child 1994). Herbicide applications to upland areas may decrease total ground cover, increasing the potential for surface erosion. In the riparian zone, use of herbicides may reduce production of deciduous trees and shrubs, opening streams to greater direct solar radiation, which in turn leads to elevated stream temperatures and increased algal production. These conditions can lead to insufficient nighttime dissolved oxygen concentrations and afternoon gas supersaturation. The loss of riparian vegetation also decreases the amount of organic litter and large wood delivered to streams. Furthermore, without the root structure of woody vegetation, banks are prone to collapse, increasing sedimentation and reducing cover for fish.

The influence of mechanical treatment and prescribed fire on aquatic ecosystems in rangelands depends on the type and intensity of disturbance. The use of tractors with dozer blades, brush rakes, cables, or rolling cutters for vegetation removal all can lead to compaction of rangeland soils (Heady and Child 1994), thus increasing surface runoff and erosion. Disking of soils may break up impervious soils and allow greater infiltration of water. Unless the area is rapidly revegetated, raindrop splashes on exposed soils are likely to increase surface erosion and increase sediment delivery to streams. Disking and dozer use also rearranges soil layers, mixing topsoil with woody debris, which may affect reestablishment of vegetation. Positive effects of mechanical vegetation removal are also possible. Removal of vegetation with high evapotranspiration rates (e.g., juniper woodlands that have encroached because of grazing and lack of wildfires) may potentially increase water available during the summer, although documentation of this effect is poor. Prescribed fire is most likely to affect aquatic ecosystems through increased surface runoff and erosion resulting from the removal of vegetation and formation of hydrophobic soils.

In summary, manipulations of vegetation on rangelands can influence salmonid habitats through both direct and indirect pathways. These changes may harm or benefit salmonids depending on whether temperature, spawning sites, cover, or food limits the production of salmonids. Salmonid abundance will decrease if the increased invertebrate production is offset by undesirable alterations in the benthos assemblage to less nutritious species, reduced cover, increased sedimentation, and lower water quality.

8. Effects on Physical Habitat Structure

Livestock-induced changes in physical structure within streams result from the combined effects of modified hydrologic and sediment transport processes in uplands and the removal of vegetation within the riparian zone. Platts (1991) and Elmore (1992) reviewed effects of grazing on channel morphology and are the sources of most information presented below. Loss of riparian vegetation from livestock grazing generally leads to stream channels that are wider and shallower than those in ungrazed or properly grazed streams (Hubert *et al*. 1985; Platts and

Nelson 1985a, 1985b in Marcus *et al*. 1990). Loss of riparian root structure promotes greater instability of stream banks, which reduces the formation of undercut banks that provide important cover for salmonids (Henjum *et al*. 1994). Furthermore, increased deposition of fine sediments from bank sloughing may clog substrate interstices and reduce both invertebrate production and the quality of spawning gravels. Over the long-term, reductions in instream wood diminish the retention of spawning gravels and decrease the frequency of pool habitats. In addition, the lack of structural complexity allows greater scouring of streambeds during high-flow events, which can reduce gravels available for spawning and cause channel downcutting.

9. Effects on Stream Biota

As with forest practices, removal of riparian vegetation by livestock can fundamentally alter the primary source of energy in streams. Reduction in riparian canopy increases solar radiation and temperature, and thus stimulates production of periphyton (Lyford and Gregory 1975). In a study of seven stream reaches in eastern Oregon, Tait *et al*. (1994) reported that thick growths of filamentous algae encrusted with epiphytic diatoms were found in reaches with high incident solar radiation, whereas low amounts of epilithic diatoms and blue-green algae dominated in shaded reaches. Periphyton biomass was significantly correlated with incident solar radiation.

While densities of macroinvertebrates in forested streams typically increase in response to increased periphyton production, the effect of stimulated algal growth in rangeland streams is less clear. Tait *et al*. (1994) found that biomass, but not density, of macroinvertebrates was greater in reaches with greater periphyton biomass. The higher biomass was a consequence of many *Dicosmoecus* larvae, a large-cased caddisfly, that can exploit filamentous algae. Consequently, any potential benefits of increased invertebrate biomass to organisms at higher trophic levels, including salmonids, may be small, because these larvae are well protected from fish predation by their cases. Tait *et al*. (1994) suggest that these organisms may act as a trophic shunt that prevents energy from being transferred to higher trophic levels.

Evidence of negative effects of livestock grazing on salmonid populations is largely circumstantial, but is convincing nonetheless. Platts (1991) found that in 20 of 21 studies identified, stream and riparian habitats were degraded by livestock grazing, and habitats improved when grazing was prohibited in the riparian zone. Fifteen of the 21 studies associated decreasing fish populations with grazing. Although they caution that some of these studies may be biased because of a lack of grazing history, the negative effects of grazing on salmonids seem well supported. Storch (1979) reported that in a reach of Camp Creek, Oregon, passing through grazed areas, game fish made up 77 percent of the population in an enclosure, but only 24 percent of the population outside the enclosure. Platts (1981) found fish density to be 10.9 times higher in ungrazed or lightly grazed meadows of Horton Creek, Idaho, compared with an adjacent heavily grazed reach. Within an enclosure along the Deschutes River, Oregon, the fish population shifted from predominately dace (*Rhinichthys* sp.) to rainbow trout over a ten-year period without grazing (Claire and Storch 1983). Platts (1991) cited other examples of improved habitat conditions resulting in increased salmonid populations.

2. Croplands

Crop production is the third most common use of non-federal land in Washington State, following grazing and timber production. Approximately half of the non-timbered private lands are devoted to crop production, with another 5 million acres in pasture or hay production. Of the harvested cropland, wheat accounts for 43 percent and hay for 39 percent, found mostly in eastern Washington. The remaining 18 percent is mostly barley, vegetables, orchards, oats, and nursery and greenhouse crops, in that order (USDA 1992).

Farming and agricultural practices result in massive alterations of the landscape, frequently resulting in long-term impacts to the aquatic and riparian ecosystems. Usually, the effects of agriculture on the land surface are more severe than logging or grazing because vegetation removal is permanent and disturbances to soil often occur several times per year. Crop production often takes place on the historical floodplains of river systems, where it has a direct impact on stream channels and riparian functions. In the Pacific Region, 21 percent of the cropland is considered "floodprone," that is, lowland and relatively flat areas adjoining inland and coastal waters such as streams, rivers, lakes and estuaries (USDA 1989). Irrigated agriculture frequently requires the diversion of surface waters, which decreases water availability and quality for salmonids and other aquatic species.

In Washington, the Puget Sound and the Yakima River Basins were selected as two of 50 of the Nation's largest river basins for inclusion in the National Water-Quality Assessment (NAWQA) program. Chemicals (primarily herbicides and fertilizers) were detected in 56 percent of the agricultural and 46 percent of the urban sites tested and approximately 20 percent of the wells tested within the upper Columbia basin exceeded the drinking water standards for nitrates (USGS 1999). The compounds detected most frequently were atrazine (38.2%), deethylatrazine (34.2%), simazine (18.0%), metolachlor (14.6%), and prometon (13.9%). Overall, nutrient levels within the Yakima drainage and the upper Columbia Basin exceeded the national median with nearly half of the sites falling in the upper 25th percentile of all NAWQA sites sampled (USGS 1999). Elevated nutrient concentrations, primarily caused by fertilizer application on fields upstream of the sample sites, contribute to excessive growth of aquatic plants and reduced levels of dissolved oxygen, which can adversely affect fish.

The loss of riparian vegetation, as a direct result of development and agricultural practices, has resulted in the majority of streams having less than 20 percent canopy cover and an average of 70 percent bank erosion (USGS 1999). The cumulative effects of channel alterations, water withdrawals, loss of streamside vegetation, elevated temperatures, and high nutrient and sediment loadings, resulted in 44 percent of the study sites having severely degraded or unsuitable habitat conditions for many native species. Furthermore, the NAWQA project examining the Central

Columbia Plateau in Washington and Idaho noted that present-day grazing and cropping practices are limiting natural recovery of the vegetation (Williamson *et al*. 1998).

The assessment showed that fish communities and instream and riparian habitat quality in agricultural portions of the basin ranked among the worst found when compared to other NAWQA sites (Wentz *et al*. 1998). Qualitative summaries of the historical effects of agriculture on aquatic ecosystems have been reported by Smith (1971), Cross and Collins (1975), Gammon (1977), and Menzel *et al*. (1984).

1. Effects on Vegetation

In Washington and throughout the west, natural grasslands, woodlands and wetlands have been eliminated to produce domestic crops. Ninety-two percent of the original fire-maintained prairies and floodplain forests of the Puget Trough have been replaced with croplands and urban development (Dunn 1997; Crawford 1997). By the late 1970's, more than 40 percent of the tidal marshes and 75 percent of the tidal swamps in the Pacific Northwest were lost, primarily due to diking (Thomas 1983). Wetland areas in most estuaries have been reduced by 50 to 95 percent due to conversion for agricultural and urban use (Boule and Bierly 1987). Replacement of natural forest and shrubland vegetation with annual crops frequently results in large areas of tilled soil that become increasingly compacted by machinery and are only covered with vegetation for part of the year. Commonly, little or no riparian vegetation is retained along streams as farmers attempt to maximize acreage in production. Although some agricultural lands may be restored to more natural communities, cropland conversion is usually a permanent alteration of the landscape.

2. Effects on Soils

Agricultural practices involves repeated tillage, fertilization, irrigation, pesticide application, and harvesting of the cropped acreage. The repeated mechanical mixing, aeration, and introduction of fertilizers or pesticides significantly alter physical soil characteristics and soil microorganisms. Further, tillage renders a uniform characteristic to soils in the cropped areas. Although tillage aerates the upper soil, compaction of fine textured soils typically occurs just below the depth of tillage, altering the infiltration of water to deep aquifers. Other activities requiring farm machinery to traverse the cropped lands, and roads along crop margins, causes further compaction, reducing infiltration and increasing surface runoff. Where wetlands are drained for conversion to agriculture, organic materials typically decompose, significantly altering the character of the soil. In extreme cases, the loss of organic materials results in "deflation," the dramatic lowering of the soil surface. Soil erosion rates are generally greater from croplands than from other land uses but vary with soil type and slope. The estimated average annual erosion measured on agricultural lands in Oregon was 5.7 tons per acre (USDA 1989).

3. Effects on Hydrology

Changes in soils and vegetation on agricultural lands typically result in lower infiltration rates, which yield greater and more rapid runoff. For example, Auten (1933) suggested that forested land may absorb fifty times more water than agricultural areas. Loss of vegetation and soil compaction increase runoff, peak flows, and flooding during wet seasons (Hombeck *et al*. 1970). Reduced infiltration and the rapid routing of water from croplands may also lower the water table, resulting in lower summer base flows, higher water temperatures, and fewer permanent streams. Typically, springs, seeps, and headwater streams dry up and disappear, especially when wetlands are ditched and drained.

Water removed from streams and spread on the land for irrigated agriculture reduces streamflows, lowers water tables, and leaves less water for fish. Often the water is returned considerable distances from where it was withdrawn, and the return flows typically raise the salinity and temperature in receiving streams. Examples of this occur in many rivers in eastern Washington. The flows of these rivers are naturally low in late summer, but the additional losses from irrigation accentuate low flows. Reductions in summer base flows greatly degrade water quality because the water warms more than normal and causes increased evaporation, which concentrates dissolved chemicals and increases the respiration rates of aquatic life.

Streams are typically channelized in agricultural areas, primarily to reduce flood duration and to alter geometry of cropped lands to improve efficiency of farm machinery. Because peak flows pass through a channelized river system more quickly, downstream flood hazards are increased (Henegar and Harmon 1971). When channelization is accompanied by widespread devegetation, the severity of flooding is increased, such as occurred in the Mississippi Valley in 1993. On the other hand, channelization of streams leads to decreases in summer base flows because of reduced groundwater storage (Wyrick 1968), which can limit habitat availability for fish and increase crowding and competition. In more extreme cases, streams may dry completely during droughts (Gorman and Karr 1978; Griswold *et al*. 1978).

4. Effects on Sediment Transport

Because of the intensity of land use, agricultural lands contribute substantial quantities of sediment to streams. The Soil Conservation Service (1984) estimated that 92 percent of the total sediment yields in the Snake and Walla Walla River basins of southeastern Washington resulted from sheet and rill erosion from croplands that accounted for only 43 percent of the total land area. The loss of vegetative cover increases soil erosion because raindrops are free to detach soil particles (splash erosion). Fine sediments mobilized by splash erosion fill soil interstices, which reduces infiltration, increases overland flow, and adds to sheet and rill erosion. Agricultural practices typically smooth and loosen the land surface, enhancing the opportunity for surface erosion. When crop lands are left fallow between cropping seasons, excessive erosion can greatly increase sediment delivery to streams (Soil Conservation Service 1984). Mass failures are probably rare on most agricultural lands because slopes are generally gentle; however, sloughing of stream banks is a common occurrence in riparian zones in response to vegetation removal.

5. Effects on Thermal Energy Transfer and Stream Temperature

Removal of riparian forests and shrubs for agriculture reduces shading and increases wind speeds, which can greatly increase water temperatures in streams passing through agricultural lands. In addition, bare soils may retain greater heat energy than vegetated soils, thus increasing conductive transfer of heat to water that infiltrates the soil or flows overland into streams. In areas of irrigated agriculture, temperatures increases during the summer are exacerbated by heated return flows (Dauble 1994).

6. Effects on Nutrient and Solute Transport

Agricultural practices substantially modify the water quality of streams. Omernik (1977), in a nationwide analysis of 928 catchments, found that streams draining agricultural areas had mean concentrations of total phosphorus and total nitrogen 900 percent greater than those in streams draining forested lands. Smart *et al*. (1985) found that water quality of Ozark streams was more strongly related to land use than to geology or soil. Exponential increases in chlorine, nitrogen, sodium, phosphorus, and chlorophyll-a occurred with increases in percent pasture in streams draining both forested and pastured catchments, and fundamental alterations in chemical habitats resulted as the dominant land use changed from forest to pasture to urban. Stimulation of algal growth by nutrient enrichment from agricultural runoff may affect other aspects of water quality. As algal blooms die off, oxygen consumption by microbial organisms is increased and can substantially lower total dissolved oxygen concentrations in surface waters (Waldichuk 1993). Nutrient enrichment from agricultural runoff has been found to significantly affect water quality in two rivers in interior British Columbia. Die-off of nutrient-induced algal blooms resulted in significant oxygen depletion (concentrations as low as 1.1 mg/L^{-1}) in the Serpentine and Nicornekl rivers during the summer, which in turn caused substantial mortality of coho salmon.

7. Effects of Fertilizer and Pesticide Use

The Puget Sound Basin National Water-Quality Assessment team compiled historical data on nutrient concentrations and streamflows for 22 rivers and streams in the Puget Sound Basin. The data were used to estimate loads and yields of inorganic nitrogen (nitrate, nitrite, and ammonia), organic nitrogen, and total phosphorus for the period 1980-1993 (Embrey and Inkpen, in press). The report estimates that approximately 11,000 tons of inorganic nitrogen and 2,100 tons of phosphorus are transported by rivers and streams to Puget Sound every year. The Samish and Nooksack River basins are dominated by agriculture. These two basins receive the largest nutrient inputs (up to 10 $(tons/mi^2)/yr$ of nitrogen and up to 1.5 $(tons/mi^2)/yr$ phosphorus), 90 percent of which comes from animal manures and agricultural fertilizers (USGS 1999). Similar findings were documented for the upper Columbia River basin. Concentrations of nitrates in surface waters in the Palouse study unit were highest during winter when storm runoff transports chemicals from agricultural fields to the streams after fertilizers have been applied to the fields in the fall. The studies also found that sediment erosion has degraded instream habitat for fish and other aquatic life and has transported some long-banned but persistent pesticides (such as DDT) to streams; concentrations of these pesticides or total PCBs exceeded guidelines for streambed sediment at 22% of the sites sampled (USGS 1999). Salmon deaths have occurred due to accidental contamination of pesticides, and sublethal concentrations have been implicated in a wide range of behavioral, immunological, and endocrine disfunctions, and indirect effects such as interference with food webs (Botkin *et al*. 1995; Ewing 1999).

Unlike native vegetation, agricultural crops require substantial inputs of water, fertilizer, and pesticides to thrive. Currently used pesticides, although not as persistent as previously-used chlorinated hydrocarbons, are still toxic to aquatic life. Where pesticides are applied at recommended concentrations and rates, and where there is a sufficient riparian buffer, the toxic effects to aquatic life may be small. However, agricultural lands are also characterized by poorly-maintained dirt roads and ditches that, along with drains, route sediments, nutrients, and pesticides directly into surface waters. Thus, roads, ditches, and drains have replaced headwater streams but, unlike natural channels which filter and process pollutants, these constructed systems deliver them directly to surface waters (Larimore and Smith 1963).

8. Effects on Physical Habitat Structure

Agricultural practices typically include stream channelization, ditch clean-out (removing woody material and increasing sediments), construction of revetments (bank armoring), and removal of natural riparian vegetation. Each of these activities reduces physical habitat complexity, decreases channel stability, and alters the food base of the stream (Karr and Schlosser 1978). Natural channels in easily eroded soils often braid and meander, creating considerable channel complexity and regular recruitement and accumulations of fallen trees. Large wood helps create deep, persistent pools (Hickman 1975) and meander cutoffs. In contrast, channelization lowers the base level of tributaries, stimulating their erosion (Nunnally and Keller 1979). The channelized reach becomes wider and shallower, unless it is revetted, in which case bed scour occurs that leads to channel downcutting or armoring. Channel downcutting leads to a further cycle of tributary erosion. Richards and Host (1994) reported significant correlations between increased agriculture at the catchment scale and increased stream downcutting.

9. Effects on Stream Biota

Agricultural practices also cause biological changes in aquatic ecosystems. In two states typified by extensive agricultural development and with extensive statewide ecological stream surveys, instream biological criteria were not met in 85 percent of the sites (Ohio EPA 1990; Maxted *et al*. 1994a). Nonpoint sources of nutrients and physical habitat degradation were identified as causes of much of the biological degradation. In another study, Maxted *et al*. (1994b) also showed that shading had marked effects on stream temperatures and dissolved oxygen concentrations. In some agricultural stream reaches without riparian vegetation, the extremes exhibited in both temperature and dissolved oxygen would preclude the survival of all but the most tolerant organisms. Higher temperatures increase respiration rates of fish, increasing oxygen demand just when oxygen is depleted by stimulated plant respiration at night. Smith (1971) reported that 34 percent of native Illinois fish species were extirpated or decimated, chiefly by siltation, and lowering of water tables associated with drainage of lakes and wetlands. Although point sources were described by Karr *et al*. (1985) as having intensive impacts, nonpoint sources associated with agriculture were considered most responsible for declines or extirpations of 44 percent and 67 percent of the fish species from the Maumee and Illinois drainages, respectively. Sixty-three percent of California's native fishes are extinct or declining (Moyle and Williams 1990), with species in agricultural areas being particularly affected. Nationwide, Judy *et al*. (1984) reported that agriculture adversely affected 43 percent of all waters and was a major concern in 17 percent of the Nation's waters.

Modification of physical habitat structure has been linked with changes in aquatic biota in streams draining agricultural lands. Snags are critical for trapping terrestrial litter that is the primary food source for benthos in small streams (Cummins 1974), and as a substrate for algae and filter feeders in larger rivers. Behnke *et al*. (1985) describe the importance of snags to benthos and fish in rivers with shifting (sand) substrates. Such systems, typical of agricultural lands, support the majority of game fish and their prey. Marzolf (1978) estimates 90 percent of macroinvertebrate biomass was attached to snags. Hickman (1975) found that snags were associated with 25 percent higher standing crops for all fish and 51 percent higher standing crops for catchable fish. Fish biomass was 4.8 to 9.4 times greater in a stream side with instream cover than in the side cleared of all cover (Angermeier and Karr 1984). Gorman and Karr (1978) reported a correlation of 0.81 between fish species diversity and habitat diversity (substrate, depth, velocity). Shields *et al*. (1994) found that incised channels in agricultural regions supported smaller fishes and fewer fish species.

On a larger scale, habitat and reach diversity must be great enough to provide refugia for fishes during temperature extremes, droughts, and floods (Matthews and Hems 1987). If refugia are present, fishes in agricultural streams can rapidly recolonize disturbed habitats and reaches. However, loss of refugia, alterations in water tables, simplifications of channels, and elimination of natural woody riparian vegetation symptomatic of agricultural regions create increased instability and results in stream degradation (Karr *et al*. 1983).

Effects of the Action

<u>Overview of effects</u>

The purpose of the CREP program is to contribute to the restoration of natural habitat conditions in riparian and wetland areas on private agricultural lands in Washington for the benefit of listed salmonids. If implemented properly, the Services expect that the program will be successful in meeting this goal. However, implementation of certain restoration practices and specific projects may cause some short- and long-term adverse effects and may take some listed species even though the projects will eventually provide important long-term benefits. Most of these potential adverse effects have been eliminated or minimized through application of the BMPs described in the BA. Where necessary, the Services have also developed Reasonable and Prudent Measures and Terms and Conditions to further minimize the potential for take.

The FSA has organized the proposed CREP program into six categories of project activities. An overview of the potential impacts associated with each of these six project groups is described below and in Table 3.

1. Streambank shaping and revegetation

Streambank shaping activities of less than 30 linear feet could cause temporary decreases in water quality (sedimentation and turbidity) and may impact existing riparian and upland vegetation. However, any such impacts will be temporary in nature and eliminated through various stabilization techniques and follow-up vegetation planting. Any excess fill materials removed during the completion of the above activities will be deposited in appropriate upland areas and stabilized to eliminate future sediment loading in streams. This activity could result in a small but unquantifiable level of harm to listed aquatic species due to stream sediment impacts. On projects that propose more than 30 linear feet of streambank shaping, FSA will carry out an additional site-specific consultation with the Services regarding the harm or other forms of take that could result from the action.

Disturbances of the stream substrates associated with instream use of heavy equipment have been documented to require decades to pass the sediment through a watershed (Madej 1978, 1982 in Montgomery and Buffington 1993). Coarse sediment is generally deposited within a meander or two of the project site. Sand and silts generally travel during higher flows and may be carried up to two miles downstream.

2. Grading/leveling/filling/seedbed preparation in riparian areas

Site preparation work will result in temporary removal of vegetation in marginal pastureland areas. Soil disturbance will occur on some sites, but BMPs, distance of these practices to streams, and the limited nature of earth moving activities will avoid most potential impacts to water quality. This activity may include the construction of small (<3 feet) mounds for planting of trees in wet sites or areas of dense competing vegetation. Revegetation of disturbed sites will ensure that any impacts are of limited duration. This activity could result in a small but unquantifiable level of harm to listed aquatic species due to stream sediment impacts. The same downstream effects of sediments moving through the system as described in the streambank shaping section apply to this activity.

3. Planting of grass, shrubs and trees

Revegetation activities will cause only minor disturbances to soils, since nearly all plantings will be done by hand. Plant growth in these disturbed sites will be rapid because planting activities will only occur during optimal seasonal growth periods for the respective plant species involved. This activity is not likely to result in take of listed species.

4. Control or removal of invasive plant species outside of streambank areas

BMPs related to handling and application of chemicals are likely adequate to minimize any water quality impacts related to these activities. Assuming FSA is successful at ensuring that pesticides and other chemicals do not enter the water body, this activity will result in no adverse effects to listed species. If pesticides do enter the water body or are not used in accordance to label specifications, this activity could result in adverse effects to listed species.

5. Installation of livestock exclusion fencing, off-channel livestock watering facilities and livestock stream crossings

Installation of fences and watering facilities in upland habitats will result in short-term loss of vegetation along the fence line and in the vicinity of watering facilities. Installation of livestock water crossings across small streams could result in an increase in sedimentation in the short- and long-term. Revegetation efforts and exclusion of livestock from riparian environments will reduce these impacts in the long term. In addition, riparian buffer zones between streambanks and fence lines will be planted with vegetation. Reestablishment of the riparian vegetation will provide streambank stabilization, reduce sedimentation of adjacent streams, increase stream shading, improve wildlife habitat, reduce nutrient inflow from adjacent agricultural lands and provide a future source of large woody debris. Installation of livestock crossing facilities may cause harm to a small but unquantifiable number of listed fish species if installation activities increase sediment inputs into the stream; relevant BMPs should minimize, but may not entirely eliminate, this potential impact. The same downstream effects of sediments moving through the system as described in the streambank shaping section apply to this activity.

Table 3. Potential adverse impacts to listed and proposed species by CREP program activities as described in the BA. Effects to listed species including may affect, but not likely to adversely affect (NLLA) and likely to adversely affect (LAA) are listed in the table below.

CREP Activity	Description	Impacts			
		Fish	Plants	Birds	Mammals
1. Streambank shaping and revegetation Activity will occur on less than 5% of CREP project area.	Shape banks to address erosion concerns. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation.	Short-term LAA Some potential to take locally occurring species	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed
2. Grading, leveling, filling, seedbed preparation in riparian areas	Installation of riparian buffer and filter strips. Some minor earthmoving. Could temporarily increase siltation.	Short-term LAA Application of BMPs may result in some take of locally occuring species if sediment inputs not adequately controlled.	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed
3. Planting of grass, shrubs, and trees.	Planting of vegetation according to standards in the riparian buffer, filter strip, and	NLAA Application of BMPs will result in no	NLAA No Incidental Take if BMPs are	NLAA No Incidental Take if BMPs are	NLAA No Incidental Take if BMPs are

CREP Activity	Description	Impacts			
		Fish	Plants	Birds	Mammals
	riparian herbaceous practices.	take of species.	followed	followed	followed
4. Control or removal of invasive plants.	Mechanical, biological, and chemical control of invasive plants. Herbicides will only be applied by hand to minimize the potential for drift and direct input of chemicals into the water body.	Application of BMPs will result in no take of species if chemicals do not enter water body. LAA if chemicals enter the water body.	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed
5. Installation of livestock fencing, off-channel watering facilities, and livestock stream crossings. Ground-disturbing activity will occur on less than 5% of CREP project area.	Install fencing, livestock watering facilities, and stream crossings to eliminate cattle from stream areas. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation.	LAA Some potential to take locally occurring species when installing livestock crossings.	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed	NLAA No Incidental Take if BMPs are followed

<u>CREP Activities Not Likely to Adversely Affect Listed Species</u>

The Services agree with FSA that many CREP activities are not likely to adversely affect listed or proposed species. These types of activities are described below.
Listed and Proposed Fish: The Services concur with FSA that the following CREP activities are not likely to adversely affect listed or proposed fish species because they will avoid the addition of significant amounts of sediment into fish habitats, they will not allow for the introduction of toxic pesticides or herbicides into these same habitats, and these actions are of low potential to cause other adverse impacts to listed or proposed fishes or their habitats:

1. The Riparian Forest Buffer Practice and Riparian Herbaceous Cover Practice when:
    1. planting is done by hand and is outside of bankfull edge;
    b. there is no grading or shaping of the streambank;
    3. chemical pesticides do not enter the stream (i.e., noxious weeds are removed by mechanical means or with chemicals applied with hand sprayers at a sufficient distance from the water body); and
    d. native species are utilized as described in the BA (BMP #17) and consistent with President Clinton's Executive Order 13112 (February 3, 1999)(see below). It is our opinion that use of non-native hybrid poplars is inappropriate under this program.

2. The Filter Strip Practice when it is installed upslope of an installed Riparian Forest Buffer or Riparian Herbaceous Cover and consistent with the BMPs in the BA.

3. Installation of livestock exclusion fencing when it is installed outside of bankfull edge and requires no instream crossings.

Listed and Proposed Plants: The CREP may affect three listed or proposed plant species (Table 2). These species are limited in their distribution, and many projects may be quickly screened to determine if there is any likelihood of affecting a listed or proposed plant. If a CREP project site occurs within a location, mapped soil unit, or soil series or type as identified in Table 2, the project site must be surveyed by a qualified botanist in the appropriate season to determine if any listed plant species are present. The application of the CREP program is not likely to adversely affect listed and proposed plants because the surveys are designed to avoid any negative impacts to listed and proposed plants through project redesign.

Listed Birds: The application of the Washington CREP program is not likely to adversely affect listed birds because FSA has agreed to the following conditions:

1. For the bald eagle, the actions occur greater than ½ mile from any eagle nest. For any project within ¼ mile non-line-of-sight or ½ mile line-of-sight of an eagle nest identified by WDFW, no activities producing noise above ambient levels will occur at the site from January 1 to August 31. If a proposed activity is near a bald eagle nest and must occur during the restricted period, site-specific consultation with USFWS will be initiated to evaluate the potential for adverse effects.

For nest sites located within areas of relatively high levels of disturbance (traffic, farm activities, urban areas, etc), the buffer distance may be negotiated and activities covered programmatically on a case by case basis after coordinating with the USFWS.

Listed Mammals: The application of the entire CREP program is not likely to adversely affect the Columbian white-tailed deer because the type of activities being considered would be considered a beneficial effect to this species due to the improvement of riparian habitat used by the deer. In addition, FSA has agreed to the following condition:

1. Fencing projects on Puget Island, the Hunting Islands, Price Island, and 2 miles inland from the Columbia River between 2 miles east of Cathlament and 2 miles west of Skamokawa Creek in Wahkiakum County will use only 3-strand barbed wire.

Most of the above actions are not likely to adversely affect aquatic listed species because they will occur outside of the bankfull edge of a stream. Activities occurring within the bankfull edge may result in short-term adverse effects and take of listed species; these are discussed below.

<u>CREP Activities That May Adversely Affect Listed Species</u>

In general, long-term effects resulting from CREP Program activities are expected to be beneficial, as the intent of the program is to restore natural stream functions. The BA stated that CREP projects may affect listed, proposed, and candidate species but are generally "not likely to adversely affect" because operational procedures (BMPs and the Services' guidance) will minimize, to the extent practicable, the effects of specific actions. The Services generally concur with this conclusion, but under some circumstances we expect that some short-term adverse effects may occur during project implementation as described below.

Listed and Proposed Fish: All 17 listed or proposed fish species addressed in this consultation may be adversely affected in the short-term by projects designed to provide long-term benefits. These activities include bank stabilization or shaping, construction of livestock crossing facilities, preparation of planting areas, and the potential for accidental leaching of chemicals into waterways. These activities could have direct or indirect, negative short-term impacts to fish during critical life stages such as migration, breeding/spawning, and juvenile rearing. Effects may result in disturbance, displacement, or alteration of habitats. Such impacts include physical interaction with eggs or alevin in the gravels, juveniles, adults, or short-term sedimentation during any instream or near stream restoration work.

Projects implemented under CREP may involve the use of certain herbicides, pesticides and fertilizers in a variety of the practices approved for use in the program in order to facilitate the establishment of the riparian buffers. The use of chemicals to control competing vegetation is a last resort after manual control methods have failed. The FSA provided materials data sheets and environmental studies for the use of 7 herbicides in the CREP program (most common trade names are listed in parentheses): Triclopyr (Crossbow, Garlon), sulfometuron-methyl (Oust), glyphosate (Roundup, Rodeo), oxyflouren (Goal), atrazine, 2, 4-D, and hexazinone (Pronone). Although these chemicals have been found by the EPA to be relatively environmentally benign, more refined toxicity ratings and long-term effects studies of agricultural chemicals on listed species are currently ongoing. Recent data indicates that the standard EPA ratings and tests which are conducted to approve chemicals for the market are inadequate at determining sublethal effects on aquatic and terrestrial organisms of concern. In addition, several studies indicate that the surfactants or carriers used in the application of some chemicals are as toxic as the active ingredient itsself. In evaluating the list of chemicals proposed for use in the CREP program, the Services prefer the use of the 5 chemicals and formulations listed in BMP #10, but have strong reservations on the use of Atrizine, Hexazinone, the ester formulation of 2,4-D, and the Garlon-4 formulation of Triclopyr. In addition, the Services prefer the formulation of glyphosate used in Rodeo over Roundup because of the toxicity ratings of the latter on aquatic organisms.

Although the Services are primarily concerned that pesticides or other chemicals may on occasion enter the water body and will directly or indirectly impact listed fish, several of the CREP chemicals have been shown to be lethal to migratory songbirds, amphibians, and/or mammals, including atrazine, triclopyr (Garlon 4 formulation), and the ester formulations of 2,4-D (Department of Ecology 1999; USFWS 2000). Because all of the CREP herbicides have the potential to be lethal to the three listed plants, botanical surveys will be required in areas where habitat for these species occurs and no chemicals will be used at these sites. If the BMPs and terms and conditions are implemented, the Services concur that application of chemicals at the lowest application rate consistent with the intended purpose using spot application with a low-pressure hand sprayers away from the water body is not likely to adversely affect listed species. If FSA expects that some CREP participants will use other application methods that have a higher likelihood of impacting listed species, we assume that "agency personnel" referred to in BMP #9 includes the Services and that we are able to review these projects prior to implementation.

The impacts of these activities will be minimized through the use of BMPs in the BA and guidelines in the Pesticides Application Handbook, as appropriate. The Services believe that any short-term negative impacts are outweighed by the long-term beneficial effects of the proposed action.

Fish Critical Habitat: These activities may also adversely affect listed or proposed critical habitat for listed fishes (see Table 1). These effects would most likely be in the form of short-term adverse effects (e.g., sedimentation) due to activities aimed at long-term habitat benefits.

Critical habitat comprises physical and biological habitat features which are essential to the conservation of a given species. Designated or proposed critical habitat supplies sufficient amounts of space, food, water, oxygen, light, and cover; identifies sites suitable for spawning, rearing, and historic distribution; and determines which areas are ecologically significant. The Washington CREP may adversely affect designated or proposed critical habitat for all of these fishes due to short-term disturbance of some or all of the above mentioned physical and biological habitat features. However, consistent with the goal of CREP to restore degraded habitats, adverse effects would be of short duration and would be substantially outweighed by the beneficial long-term effects of habitat restoration.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to FSA's CREP are not considered in this section because they require separate consultation under Section 7 of the ESA.

Currently, about 37% of Washington's land base is being used for agriculture. Approximately 74% of water use state-wide is used by agriculture. Few activities associated with agricultural land use require federal permits. Major historical impacts of agricultural activities have been increased sediment loading, loss of riparian vegetation, loss of productive side-channel habitat, pesticide contamination and excess nutrient loading. Many of these impacts continue to occur today.

In 1999, the State of Washington published a *Statewide Strategy to Recover Salmon* (State of Washington 1999) intended as a guide for salmon recovery. Included in that document is an agricultural strategy to improve fish habitat. This strategy (which includes the CREP program as a cornerstone), if implemented, could gradually reduce many of the impacts identified above. Also in 1999, a state led effort began to devise an Agriculture, Fish and Water initiative. This initiative is in the beginning stages at this time, but holds promise to result in reductions in agricultural impacts across the State.

For actions on non-Federal lands which the landowner or administering non-Federal agency believes are likely to result in adverse effects to listed species or their habitat, the landowner or agency should work with the Services to obtain any necessary incidental take permits under section 10 of the ESA, which requires submission of a habitat conservation plan.

Significant improvement in listed and proposed anadromous salmonid reproductive success on non-Federal lands is unlikely without meaningful changes in agricultural land and water management practices. Until improvements in non-Federal land management practices are accomplished, the Services assume that future private and state actions will continue at similar intensities as in recent years, or will increase.

Conclusion

The Services have determined, based on the information, analysis, and assumptions described in this Opinion, that FSA's proposed Washington Conservation Reserve Enhancement Program is not likely to jeopardize the continued existence of the listed and proposed species under the respective jurisdictions of NMFS and USFWS shown in Table 1. In arriving at this determination, the Services considered the current status of the listed and proposed species; environmental baseline conditions; the direct and indirect effects of approving the action; and the cumulative effects of actions anticipated in the action area. The Services have evaluated the proposed action and found that it would cause short-term adverse degradation of some environmental baseline indicators for listed and proposed fishes. Since the CREP program is designed to restore habitat conditions, the effects are expected to be beneficial over the long term. The short-term effects of the proposed action would not reduce pre-spawning survival, egg-to-smolt survival, or upstream/downstream migration survival rates to a level that would appreciably diminish the likelihood of survival and recovery of proposed or listed fishes, nor is it likely to result in destruction or adverse modification of critical habitats.

CREP represents an important contribution to the recovery of listed salmonids in Washington. Although the Services believe that the implementation of CREP will result in overall benefit to listed and proposed salmonids and their habitats, the reasons for the declines of salmonid fishes in the Pacific Northwest are varied and complex, and this program alone will not be sufficient to achieve recovery. The restoration activities are expected to meet the objectives of the Washington CREP program, particularly if the landowners maintain the riparian buffers beyond the 15 year contract agreement. The ecological functions provided by the conservation practices implemented as part of CREP will be evaluated through the implementation of the MOU between NRCS, USFWS, NMFS, EPA, and the State of Washington.

The biological opinion is rendered on the effects of the proposed activities within the riparian zone and is not, per se, an opinion on the adequacy of the buffer to meet all of the requirements for listed species. Both Services have determined that the riparian restoration activities, if installed in accordance with the criteria outlined in the Washington CREP, work towards recovering listed and proposed salmonids and are designed to provide the majority of riparian functions, particularly if maintained beyond the length of the contract (15 years). The CREP buffers would also serve to significantly minimize or eliminate potential effects to listed salmonids from activities that are conducted on lands beyond the buffer, such as livestock grazing, working fields, and proper use of chemicals on crops. Landowners who enroll in and implement the CREP program will be in compliance with the Endangered Species Act for activities that are addressed in this consultation. However, a forested riparian zone may not be adequate to reduce the effects of other farm practices on listed species, such as water withdrawals, drainage and irrigation, or activities that impact water quality or affect habitat for listed species.

If the FSA should seek a concurrence on the adequacy of the width of the riparian forest buffer, an analysis on how various forest buffer widths provide different levels of riparian and aquatic ecological functions would be needed. For example, a functional forested buffer width of one-half a site-potential tree height may provide adequate bank stability during normal high water events and most of the organic material input from litter fall, but may only meet 70 percent of the requirements for shade or the potential for recruitment of large wood into the channel. Similarly, buffer widths of three-quarters of a site potential tree height likely provide most of the riparian functions relating to bank stability, shade, leaf litter, filtration, etc., but may not be fully adequate in meeting long-term recruitment of large wood within the channel migration zone. If one of the limiting factors for restoring listed fish species is instream habitat complexity and the amount of large woody material, the analysis would need to demonstrate how the riparian buffer, in conjunction with other restoration activities, would adequately meet this criteria. The analysis should also address what functions can be achieved in the relatively short time period of the program (15 years) and how the CREP program might be enhanced to ensure that the buffers are maintained to meet the long term recovery goals outlined in the program objectives.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, spawning, rearing, migrating, feeding, or sheltering (64 Fed. Reg. 60727; 1999). Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Under the terms of section 7(b)(4) and section 7(a)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Sections 7(b)(4) and 7(o)(2) of the Act do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for removal and possession of endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

In general, an incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth mandatory terms and conditions required to accomplish the reasonable and prudent measures.

Amount of take anticipated

Certain site-specific actions associated with the Washington CREP program may incidentally take an unquantifiable number of listed fish species shown in Table 1. The amount of take is anticipated to be small and of a temporary nature. Designated critical habitat for listed salmonids may be adversely affected by CREP project implementation, but the negative effects are expected to be short-term. The potential for take has been substantially reduced through the application of the BMPs. The Services have determined that the level of anticipated take resulting from implementation of the Washington CREP is not likely to jeopardize any of the species nor adversely modify designated critical habitats shown in Table 1.

It is difficult to detect take of salmonids or other aquatic species, even where they are known to occur. The presence of aquatic vegetation, stream flow, and rapid rates of decomposition make finding an incidentally taken individual fish extremely unlikely, and effects such as interfering with feeding may be even more difficult to detect. Furthermore, beneficial effects of management actions are largely unquantifiable in the short term and may only be measurable as long-term effects on the species' habitat or population levels. Although the Services expect incidental take of salmonids to occur from the “likely to adversely affect” actions addressed in this consultation, the best scientific and commercial data available are not sufficient to enable the Services to estimate the number of individuals that would likely be taken incidentally in association with actions implemented in the Washington CREP program. Therefore, the Services can only quantify incidental take using surrogate units of measure for each CREP activity that may result in adverse effects to listed species. For example, the unit of measure for bank stabilization would be expressed as number of miles affected for each site, while planting and control of unwanted vegetation could be measured as acres or miles of riparian area treated. Actions within the riparian area will be highly variable and effects on the aquatic environment will depend on such things as the width of the planted buffer and whether both or only one side of the stream is treated. Actions which may be repeated several times over the course of the program could result in repeated incidental take for the same area.

Although there is no way to evaluate an accurate level of take because the program is dependent on voluntary applications from private citizens, the action agencies can determine the maximum amount of incidental take that is likely to occur if all of the areas that are eligible under the CREP program are treated.

The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if implementation of the CREP program is in compliance with the terms and conditions specified herein.

Table 4: Anticipated levels of incidental take from implementation of the Washington CREP program. Up to 100,000 acres (or approximately 4,000 miles) of riparian area are approved for treatment under the program. Anticipated levels of incidental take associated with each of the activities listed below represent the amount of disturbance for each site within the areas identified under the CREP program over the entire life of the program (15 years).

CREP Activity	Description	Anticipated Maximum Stream Miles within which Take May Occur over 15 years	Estimated Annual Miles within which Take May Occur
1. Streambank shaping and revegetation Activity will occur on less than 5% of the total 4,000 miles eligible.	Shape banks to address erosion concerns. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation. Downstream impacts may occur up to 2 miles from the project site	200	13
2. Riparian buffer planting and seedbed preparation in riparian areas Target is 2,700 miles of stream restoration over the next 15 yrs	Installation of riparian buffer and filter strips. Some minor earthmoving. Could temporarily increase siltation.	2,700	213
3. Installation of livestock fencing, off-channel watering facilities, and livestock stream crossings. Activity will occur on less than 5% of the total 4,000 miles eligible.	Install fencing, livestock watering facilities, and stream crossings to eliminate cattle from stream areas. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation. Downstream impacts may occur up to 2 miles from the project site	200	13

Reasonable and prudent measures

The measures described below are non-discretionary. They must be implemented as binding measures for the exemption in section 7(a)(2) to apply. The FSA has the continuing duty to regulate the activities covered in this incidental take statement. If the FSA fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(a)(2) may lapse. The Services believe that activities carried out in a manner consistent with the BMPs and these Reasonable and Prudent Measures, except those otherwise identified, will not necessitate further site-specific consultation. Activities which differ from the BMPs or RPMs will require further consultation.

The Services believe that the following reasonable and prudent measures are necessary and appropriate to minimize the likelihood of take of listed fish resulting from implementation of the Washington CREP. Should additional habitat inhabited by listed species be designated as critical habitat, these reasonable and prudent measures would also minimize adverse effects to that habitat.

The FSA shall:

1. Ensure the development and implementation of a comprehensive monitoring program to assess the effectiveness of the CREP in meeting its objectives;

2. Avoid take of listed species in any restoration activities that are part of the Washington CREP;

3. Manage herbicides, pesticides and other chemicals as needed to ensure that no degradation of water quality, aquatic habitats and wetlands occurs in the activity area and downstream;

4. Locate, design and maintain livestock crossings or fords as necessary to minimize degradation of riparian and aquatic habitats in the activity area and downstream; and

5. Minimize take associated with instream work or ground-disturbing activities within the riparian zone proposed in the CREP BA (i.e., streambank stabilization, site-preparation, off-channel livestock watering facilities, and livestock crossings) by applying appropriate timing restrictions.

Terms and conditions

In order to be exempt from the prohibitions of section 9 of the Act, the FSA must also comply with the following terms and conditions, which implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure #1, above, the FSA shall:

Provide NMFS and USFWS with a yearly monitoring report describing the success with which the Washington CREP meets the program objectives. This report will include implementation and effectiveness monitoring components.

Implementation Monitoring The annual implementation monitoring report shall focus on summarizing CREP enrollment, including: the level of program participation; the total acres and average widths enrolled in each of the component conservation practices; the total number of acres and distribution of successfully implemented conservation practices; a summary of non-Federal CREP program expenditures; and recommendations to improve the quality of the monitoring program. The Services are particularly interested in an accounting of CREP projects which include streambank stabilization. For those projects, include the following information in the monitoring report: the number of such projects each year, the justification for the work, materials used, size of the project, whether one or both banks were stabilized, and a narrative assessment of each project's effects on natural stream function.

Effectiveness Monitoring This component of the annual report will assess habitat trends as a result of CREP participation, and will specifically focus on the six objectives of the Washington CREP as defined by FSA:

1. Ensure that 100 percent of the area enrolled for the riparian forest practice are restored to a properly functioning condition in terms of distribution and growth of woody plant species.

B. Reduce sediment and nutrient pollution from agricultural lands adjacent to the riparian buffers by more than 50 percent.

3. Ensure that adequate vegetation is established on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.

D. Ensure that vegetation adequate to reduce the rate of stream water heating to ambient levels is achieved on all riparian buffer lands.

5. Provide a contributing mechanism for farmers and ranchers to meet the water quality requirements established by the Federal Water Pollution Control Act and Washington State's Department of Ecology agricultural water quality laws.

F. Provide adequate riparian buffers on at least 2,700 miles of stream to permit natural restoration of stream hydraulic and geomorphic characteristics which meet the habitat requirements of salmon and trout.

The FSA shall ensure the design and implementation of a scientifically credible, statistically robust monitoring plan that focuses on the six objectives listed above. The CREP effectiveness monitoring program will use a standardized design and single set of protocols to facilitate data analysis and interpretation. This monitoring program may make use of existing monitoring efforts if those results do not violate the scientific or statistical credibility of the CREP monitoring program and can provide data specific to CREP objectives. FSA will develop this quantitative monitoring program in consultation with a biostatistician to ensure that the monitoring design and protocols will adequately assess CREP effectiveness in achieving its objectives.

The annual report shall be submitted to:

Stephen W. Landino, Branch Chief
National Marine Fisheries Service
510 Desmond Drive SE
Lacey, WA 98503

and

Gerry M. Jackson, Manager
U.S. Fish and Wildlife Service
Western Washington Office
510 Desmond Drive SE
Lacey, WA 98503

Implementation of a monitoring program will reduce take associated with CREP actions by ensuring that BMPs are carried out as stated in the BA and in this Biological Opinion. Implementation and effectiveness monitoring will determine whether BMPs provide the expected level of protection to listed species. If monitoring indicates that BMPs are not adequate to protect listed species, this information can be used as feedback to improve the program.

2. To implement Reasonable and Prudent Measure #2, above, the FSA shall:

Consult with field biologists from WDFW and the Services to review site-specific streambank stabilization and livestock crossings that include the operation of heavy equipment and may contribute sediments to the stream or result in the damage of desirable riparian vegetation. All instream operations will require a hydraulics permit and must meet the state's site-specific instream timing restrictions.

3. To implement Reasonable and Prudent Measure #3, above, the FSA shall:

Include the following terms and conditions in each project specification calling for pesticides or other chemical applications.

A. Few of the many registered pesticides have been subject to section 7 consultation under the Act. For some of those that have, the EPA has produced supplemental endangered species label guidelines. For all CREP projects, follow all EPA guidelines addressing threatened and endangered species (e.g., listed plants in Willapa Hills, Clark, and Okanogan counties).

B. All chemical applicators shall follow label specifications and guidelines outlined in the Washington Pesticide Application Manual.

C. When operating within 25 feet of water (including streams, ponds, seeps, springs, bogs, wetlands, standing water ponds, and riparian areas), applicators will conduct a special, site-specific evaluation and will follow the guidelines outlined in BMP #10 for the 7 chemicals used in the CREP program. These pesticides will be applied at the lowest application rate consistent with the intended purpose.

4. To implement Reasonable and Prudent Measure #4, above, the FSA shall:

Include the following terms and conditions in each project specification calling for livestock crossings or fords. Livestock crossings, or fords, are intended to provide a stabilized area to provide access across a riparian buffer and waterway for livestock and farm equipment.

1. Do not place crossings in areas where listed salmonids spawn or are suspected of spawning, or within a reasonable distance (e.g., 100 feet) upstream of such areas where impacts to spawning areas may occur.

B. Minimize the number of crossings.

3. Design and construct or improve essential crossings to accommodate reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the road if there is crossing failure.

A. Stabilize bank cuts, if any, with vegetation and protect approaches and crossings with river rock (not crushed rock) when necessary to prevent erosion.

4. Ensure that livestock crossings in and of themselves do not create barriers to the passage of adult and juvenile fish.

5. To implement Reasonable and Prudent Measure #5, above, the FSA shall:

Implement instream work consistent with WDFW's Hydraulic Code, available on the web in *Gold and Fish - Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources* (see WDFW's Web Page at www.wa.gov/wdfw/hab/goldfish/goldfish.htm - location and timing requirements section for the most current version of these guidelines).

The incidental take statement included in this Biological Opinion is limited to the Act. It does not constitute an exemption for non-listed migratory birds and bald and golden eagles from the prohibitions of take under the Migratory Bird Treaty Act of 1918, as amended (U.S.C. 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (U.S.C. 668-668d), or any other Federal statutes.

The Services should be notified within three (3) working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact our Law Enforcement Office at (425) 883-8122 or the Western Washington Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" is defined as suggestions from the Services regarding discretionary agency activities to: 1) minimize or avoid adverse effects of a proposed action on listed species or critical habitat; 2) conduct studies and develop information; and 3) promote the recovery of listed species. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the FSA's 7(a)(1) responsibilities.

The Services recommend that the following conservation measures be implemented:

2. **Work with NRCS and the Washington State Conservation Service and other partners to ensure the long-term viability of CREP riparian buffers.**

The services are concerned that some riparian forest buffers may be designed to encourage subsequent timber harvest in the buffers. Such an approach is inconsistent with the basic intent of the CREP program.

The Services are concerned about the long-term viability of the CREP riparian buffers and exactly how the NRCS Riparian Forest Buffer Standard will apply to agricultural lands enrolled in CREP. The science is clear that maintenance of these buffers beyond the 10 to 15-year enrollment period is critical to the long-term recovery of listed salmon and trout. Although some short-term benefits will accrue within the first few years of buffer installation, many of the habitat attributes most important to salmonids (e.g., large trees, improved stream morphology, etc.) will not fully develop in 10 or 15 years. In addition, the target fish populations will require more time to respond to improved conditions and reverse the declining trend in numbers.

If future timber harvest were allowed in the riparian zone, it could result in substantial Federal CREP funds being spent to install riparian habitat features that are subsequently removed before they reach their full potential to improve salmonid habitat. This outcome would be an unwise use of limited Federal conservation funds.

The Services therefore recommend that FSA and State agencies not relax existing forest practice standards to encourage participation in the CREP program. Instead, the Washington Department of Natural Resources and other participating agencies should fully inform landowners that salmonid recovery will likely require longer term commitments to be successful. FSA and the State should focus efforts on encouraging willing landowners to retain these important buffers beyond the enrollment period, and they should not take action that would in fact encourage buffer removal.

2. **Widen riparian buffers.**

The width of riparian buffers are currently limited to 150 feet. The Services recommend that greater riparian buffer widths (possibly tied to floodplain boundaries) be routinely encouraged in CREP contracts in order to maximize the development of fully formed and functional riparian areas under CREP.

3. **Use native vegetation.**

The BA states that native vegetation will be used for plantings (BMP #17). The Services support FSA's stated desire to use native vegetation, especially given President Clinton's recent Executive Order 13112 addressing invasive species and the restoration of native species. The Service believes that use of hybrid poplar is inappropriate for the CREP program and is inconsistent with Executive Order 13112. The Service assumes "feasible" means that appropriate native stock are available to meet the CREP project needs in sufficient quantities and at a reasonable cost. Use of non-native stock or seed should only occur after a good faith attempt has been made to locate native materials.

4. **Conduct a sustainable agriculture analysis.**

FSA, in coordination with other USDA agencies and programs, should continue and expand efforts to provide information and technical assistance that will allow agricultural producers and other interested parties to evaluate alternative conservation systems necessary to recover declining aquatic species and their habitats, and costs associated with those systems, in a timely manner.

Short-term land retirement programs such as CREP are costly and cannot fully address the need for more sustainable agricultural practices that fully integrate environmental, economic and social needs. The CREP Co-op Agreement concerning USDA's commitment to the Washington CREP included provisions for development of land and water conservation plans.

Most producers are motivated to choose management options that maximize profits. Impacts to declining species are not reflected in market signals, however, so conflicts arise between production and species needs. Giving producers information about government programs and conservation systems that not only meet the requirements of the Act but can be relied on to produce consistent, acceptable crop yields is very likely to increase their acceptance of conservation practices as part of their overall farm or ranch management system. Thus, developing such information for Washington's many distinct growing areas is an urgent and high priority need.

USDA has the capacity to develop innovative research and technology transfer tools that will provide agricultural producers in Washington with the tools they need to protect and restore aquatic ecosystems while achieving more cost-efficient production and increased profitability. For example, the Solutions to Environmental and Economic Problems (STEEP) project conducted in the Pacific Northwest which began in 1975 to develop and accelerate adoption of wheat production practices that control soil erosion became a national model for unified regional research and information transfer. A similar program is now needed to solve problems related to the environmental and socioeconomic impacts of alternative conservation systems necessary to restore riparian and aquatic habitats and increase salmonid survival. Three specific information and technical assistance needs are:

- Development of geographic and sector specific conservation systems to meet the needs of listed species while ensuring agricultural productivity.

- Analyses of socioeconomic barriers to the adoption of conservation systems, such as conflicts between conservation and production goals, agricultural traditions, and producer assumptions about cost and risk aversion.

- Development of a market-based strategy to deliver new riparian and aquatic conservation systems to Washington's diverse agricultural sectors.

5. **Implement additional conservation incentives.**

FSA, in coordination with other USDA agencies and programs, should continue and expand efforts to make adoption of alternative riparian and aquatic conservation systems necessary to recover declining aquatic species and their habitats more cost effective for agricultural producers.

The Washington CREP provides a substantial incentive for enrollment of certain acreage under the program. After these short-term contracts expire, however, the future use of enrolled acres will depend primarily on economics and related factors. Among other considerations will be the compatibility of permanent vegetative cover with existing use of adjacent land; the desirability and cost of conversion from crop production to other land uses such as grazing, forestry, or urbanization; geographic isolation of various tracts; and the availability of other incentives to continue conservation systems.

CREP and other conservation provisions of the Federal Agricultural Improvement and Reform Act of 1996 (the 1996 Farm Bill) were specifically designed to address high priority conservation needs. Administration of those programs by FSA, NRCS and other partners make a vital contribution to national environmental goals. However, authorization and funding for those programs will expire in 2002. Moreover, Farm Bill programs specifically targeted for conservation represent only a small fraction of the total number of agricultural programs available to producers. Many other agricultural programs administered by FSA and other USDA agencies, such as marketing, commodity and loan programs, may also have a significant direct or indirect effect on the likelihood of producers adopting conservation systems that would improve the survival of listed salmonids.

In view of the need for additional incentives to continue and expand existing conservation program benefits and achieve permanent adoption of sustainable agricultural practices and conservation systems, it is important that FSA, in coordination with other USDA agencies, investigate opportunities to include conservation incentives as part of other agricultural programs. Examples of expanded incentive opportunities include enhanced program benefits, premiums, purchasing preference or promotional assistance for beneficiaries who adopt appropriate conservation systems; targeted research, education or demonstration programs; and other "debt for nature" ideas. Alternatively, USDA should develop conservation-based eligibility criteria for its agricultural programs. Examples of FSA and other USDA programs to include in this investigation are:

- FSA programs to provide farm and commodity loans, dairy price support, domestic and foreign food assistance, catastrophic crop insurance and crop disaster assistance, emergency assistance for farmers in declared disaster areas, and farm ownership.

- Foreign Agricultural Service programs to provide incentives for eligible promotions and develop foreign markets for agricultural commodities.

- Risk Management Agency programs to provide crop insurance and other risk management assistance.

- Agricultural Marketing Service programs to provide marketing incentives through Marketing, Promotion and Information Boards.

- NRCS programs to provide conservation technical assistance, carry out the Conservation Farm Option pilot and other conservation provisions of the 1996 Farm Bill, reach out to socially disadvantaged farmers and ranchers, farmland protection, reduced flood risk, forestry incentives, and promotion of sustainable agricultural systems.

6. **Expand geographic boundaries of CREP.**

To further meet FSA's section 7(a)(1) requirement under the Act to utilize its authorities to conserve listed species, FSA should expand the geographic boundaries of the Washington CREP program to include all Washington basins, and not just those inhabited by listed salmonids. This would allow farmers and ranchers in other watersheds to enroll in CREP and do their part to protect other listed and/or rare aquatic species. In some cases, expansion of the CREP program could play an important role in helping to conserve otherwise rare species prior to the need to list them as threatened or endangered.

7. **Validation Monitoring**

Design and implement a long-term validation monitoring program to document the overall impact of the CREP on fish species of concern. The objective of this component of the monitoring program would be a quantitative comparison of salmon and trout habitat characteristics and salmonid population trends in streams where there is enrollment in this program with similar streams where program participation is not significant.

8. Enhanced Plant Conservation

Currently, the CREP proposed action calls for designing CREP projects such that they “avoid” impacts to listed or proposed plant species. While this will likely result in a reduced consultation workload for USFWS through avoidance of impacts to these species, it may also result in missed opportunities to conserve these species by providing protection within, for example, wetland areas or riparian buffers developed or protected through CREP. Consequently, USFWS recommends that FSA encourage CREP participants and implementing agencies to consider conservation measures for these plants through follow-up, site-specific consultations where CREP projects might benefit the plant species addressed in Table 2 of this Biological Opinion. The USFWS will be glad to provide technical assistance in the design of such projects.

In order for the Services to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitats, the Services request notification of the implementation of any conservation recommendations.

REINITIATION OF CONSULTATION

This concludes formal consultation on the Oregon Conservation Reserve Enhancement Program. As required by 50 CFR Part 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations that are causing such take must be stopped, and formal consultation must be reinitiated. If you have questions regarding this Biological Opinion, please contact Martha Jensen at the U.S. Fish and Wildlife Service (360/753-9000) or Gordy Zillges at the National Marine Fisheries Service (360/753-9090).

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